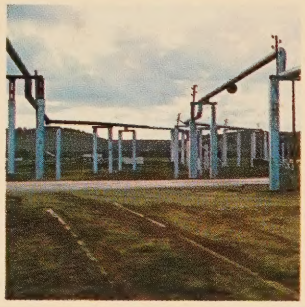
Siberia 1971









Siberia 1971:

A Report on the Visit of the Honourable Jean Chrétien, Minister of Indian Affairs and Northern Development and Official Delegation to the Soviet Union

July-August 1971

by Walter Slipchenko

Part IV

Discussions in Siberia

Part V

Part VI

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Foreword

In July of this year I had the pleasure of leading a Canadian delegation to the Soviet Union and in particular to Siberia. My host was Mr. I. T. Novikov, First Deputy Chairman of the Council of Ministers, USSR, and Chairman of the State Committee of Construction, USSR. In a short span of 16 days we were able to meet with members from a wide variety of local and regional governing bodies, and scientific and research institutes as well as with members of certain native groups, and to travel approximately 11,000 miles in the USSR , of which 9,000 were in Siberia.

Wherever we went in Siberia we witnessed 20th Century progress. There is no doubt that the Soviet Union has accomplished a great deal in the development of its north, especially in such areas as hydro-electric power, mining, natural gas exploration and exploitation, forest industries, and in the traditional pursuits of hunting, fishing and reindeer-herding. Significant in this development has been the number of institutes and scientific organizations which have directly supported and contributed to this program.

My delegation was most impressed by the warm welcome we received wherever we went, and by the emphasis of continuing co-operation and increased bilateral exchanges between our two countries. I am convinced that further co-operation will be achieved in the broad field of Arctic development and shall include, essentially, all activity in the far north. The purpose of this report is to record the exchanges we had with various officials in the Soviet Union and to list our impressions.

I am grateful to the Soviet Government for having provided us with a stimulating and interesting visit to their country, and also to the various Soviet officials and people we met who contributed in so many ways to the success of our tour. It is my hope that our presence contributed towards increased understanding between our two countries and that it will pave the way for expanded co-operation in the future.

I hope many Canadians will read it and be inspired by the potential of northern lands; will recognize more of the possibilities of our own north and will renew and re-invigorate the Canadian commitment to the north.

Jean Chrétien

Acknowledgements

The Honourable Jean Chrétien, together with a group of Canadian specialists, visited the Soviet Union July 19 to August 5, 1971 as guests of the State Committee on Construction USSR. It was obvious from the outset that our Soviet hosts had made a determined effort to arrange access to most of the areas in Siberia which members of the group wished to visit. Upon our return it was decided to publish an account of the events and impressions of the 16-day visit.

This report is based on information provided by each member of the delegation. In spite of limitations imposed by the shortness of our stay and the technical constraints of the report itself, an attempt has been made to record, as objectively as possible, the highlights of each meeting and to present a graphic description with the aid of photographs of the area we visited in Siberia. The report brings together the views of various senior Soviet officials on the development of Siberia, particularly the northern regions.

Many people contributed to this publication and I would like to thank them for their help. Although the majority of the photographs were supplied by Mr. R. M. Hill, Mr. C. R. Hetherington and Mr. S. M. Hodgson also contributed. Mr. Kojoh Mensah drafted the working maps from a variety of sources, while Mr. B. D. Norgren and his staff Mr. M. L. Jay, Mr. J. W. Bogart, and Mr. A. Castonguay produced the final drafts with a number of improvements. The advice and assistance of Peter Hancock, Mr. L. A. C. O. Hunt, Mr. G. W. Rowley and Dr. P. J. Usher as well as members of the office of the Public Information Adviser were most invaluable. Arthur Petch assisted in co-ordinating and reviewing various sections while Mrs. Helen Maloney and Mrs. Ida Lamb were responsible for typing all the drafts. Ultimately, I accept all responsibility for the report and for any errors which may have occurred.

Walter Slipchenko
November, 1971

1 Ottawa: L. to R.: Mr. W. Slipchenko, Mr. V. I. Vorobiev (Soviet Embassy), Mr. J. M. Lowe, Mr. R. M. Hill, Mr. A. D. Hunt, Mr. J. J. Buchanan, Mr. J. Chrétien, Mr. S. M. Hodgson, His Excellency B. P. Miroshnichenko (Soviet Ambassador), Mr. C. R. Hetherington, Mr. A. St-Amant, Mr. B. E. Kovalsky (Soviet Embassy) and Mr. S. M. Belyaev (Soviet Embassy). Missing from photo Mr. J. T. Fournier.

1

Part I Introduction

1 Format of the Report

This report is made up of the following six parts: introduction, general information, discussion in Moscow and Leningrad, discussions in Siberia, statement by the Honourable Jean Chretien at the conclusion of the trip, and a final section dealing with conclusions. Although the report is more general than technical, it does contain a certain amount of technical information which was supplied by the specialists in the delegation. Since the trip was so brief and visits to each locality had to be curtailed members had only limited access to scientific and technical sources.

The introduction gives the primary aims of the visit, the delegates who were present, the itinerary, and a Russian-English transliteration table. The table explains the method used in transliterating personal and geographical names from Russian to English. It will be noted that the maps used in the report are not in complete agreement with the table since they were drawn before a system of transliteration had been adopted.

In Part II an attempt has been made to provide general information on the administrative divisions of the territories which constitute the Union of Soviet Socialist Republics, on the State Committee on Construction, USSR (GOSSTROI, USSR) and on Soviet northern development. This final section was prepared for delegates before their visit to the Soviet Union to provide a better understanding of the socio-economic and technological development in Siberia.

Discussions at various meetings held in Moscow and Leningrad are included in Part III, while Part IV deals with the meetings and observations which occurred in Siberia. These notes are a compilation of all the comments as recorded by various members of the delegation. In instances where only one member was involved in a particular discussion his name appears in brackets as the originator of the statement. At the conclusion of several meetings it was found useful to record conversations with our Soviet hosts in a question and answer format. It should be noted that these are not transcriptions of actual dialogue, so much as a record of the basic elements of inquiry and reply, as they were understood by the writer.

Part V contains Mr. Chrétien's final statement to Mr. I. T. Novikov at the conclusion of the tour. In the conclusions, an attempt is made to review the entire visit and evaluate its importance for future exchanges with the Soviet Union.

2 Objectives of the Visit

The primary objectives of the visit were outlined in a press release dated July 14, 1971.

> "The Canadian party will have discussions with senior Soviet officials in Moscow and Leningrad and the remainder of the time will be spent visiting various centres in Siberia where they will have an opportunity to study resource development in certain areas of the Soviet North; the social and economic development of the native people; a hydro-electric project, an operating pipeline and a gas field on permafrost.
>
> Commenting on plans for his visit to the Soviet Arctic, Mr. Chrétien said exchanges of delegations and access to each other's northern experiences in human as well as in scientific and technological terms would be of direct benefit to Canada and could also assist in the development of harmonious and mutually beneficial relations between the two countries.
>
> The Minister expressed the hope that it would be the forerunner of many exchange visits by both countries, based upon the Canada-Soviet Protocol on Consultation signed by the Prime Minister in Moscow recently, and confirmed that he will discuss with Soviet officials a program for expanded bilateral northern exchange with the USSR, particularly in the areas of science and technology, including the design, construction and operation of buildings and other structures on permafrost; the management and development problems related to conservation and pollution; living standards in northern areas, and government assistance for native populations."

Map 1
Itinerary

--- International Boundary

○ Stop-Over

● Stopped for Refuelling

3 Members of the Delegation

The Honourable Jean Chrétien
Minister of Indian Affairs and
Northern Development

Department of Indian Affairs and Northern Development
J. J. Buchanan
Parliamentary Secretary
J. T. Fournier
Executive Assistant
A. D. Hunt
Assistant Deputy Minister
(Northern Development Program)
W. Slipchenko
Research Officer
Northern Science Research Group
R. M. Hill
Manager
Inuvik Research Laboratory

N.W.T. Government
S. M. Hodgson
Commissioner of the
Northwest Territories.

Canadian Embassy in Moscow
Peter Hancock

Northern Canada Power Commission
J. M. Lowe
General Manager

Pan Arctic Oils Ltd.
Charles R. Hetherington
President.

St-Amant, Vézina, Vinet, Brassard Consulting Engineers
A. St-Amant

4 Itinerary

		Ottawa–Montreal
July 19	1015	Left Ottawa for Montreal
	1845	Left Montreal for Moscow via Copenhagen
		Moscow
July 20	1045	Arrived Moscow
	1500	Meeting at GOSSTROI to discuss itinerary and the Soviet Construction industry
	1730	Visit to a construction site in Moscow
July 21	0930	Meeting at the Council of Ministers, RSFSR
	1200	Lunch given by Mr. I. T. Novikov, Chairman of GOSSTROI
	1400	Meeting at the Committee of Science and Technology
	1530	Meeting at the Ministry of the Gas Industry
July 22	1000	Meeting at the State Planning Committee (GOSPLAN)
	1200	Meeting at the Ministry of the Oil Industry
		Leningrad
July 23	1000	Meeting at the Arctic and Antarctic Institute
	1130	Meeting at the Leningrad Zonal Research Institute of Experimental Design
	1300	Visit to the Ethnographical Museum (Division of Northern People)
July 24		Sightseeing in Leningrad
		Flight Leningrad–Yakutsk
July 25	0800	Leave Leningrad
	1300	Arrive Omsk
	1330	Depart Omsk
	1535	Arrive Krasnoyarsk
	1650	Leave Krasnoyarsk
		Yakutsk
July 26	0245	Arrive Yakutsk
	1000	Meeting at the Council of Ministers, Yakut ASSR
	1300	Meeting at the Yakutsk State University
	1600	Visit to the "Yakutskenergo" (Yakutsk Energy Organization) and Thermal Plant
	1700	Visit gas pipeline and distribution centre
	1800	Visit the Professor M. F. Gabyshev Fine Arts Museum
July 27	0930	Meeting at the Permafrost Institute
	1030	Meeting at the Siberian Branch of the Academy of Science
	1200	Visit to the "Yakuttyazhstroi" (Yakut Heavy Industry Construction Project)
	1300	Visit to the P. A. Oyunski Museum

		Flight to Yakutsk–Cherski–Zeleny Mys–Nizhnekolymsk Sovkhoz
July 28	0600	Leave Yakutsk
	1215	Arrive Cherski
	1400	Take boat from Cherski to Zeleny Mys
	1430	Visit Port and "Northern Lights" power station
	1500	Return to Cherski
	1530	Leave Cherski for Nizhnekolymsk Sovkhoz
	1700	Arrive at reindeer station
		Flight Nizhnekolymsk–Cherski–Batagai–Yakutsk
July 29	0915	Leave Nizhnekolymsk
	1100	Arrive Cherski
	1130	Leave Cherski
	1400	Arrive Batagai for refuelling
	1430	Leave Batagai
	1645	Arrive Yakutsk
		Flight Yakutsk–Mirny
July 30	0845	Leave Yakutsk
	1100	Arrive Mirny
		Mirny
July 30	1115	Meeting at Regional HQ.
	1400	Briefing at Yakutalmaz (Diamond Combine HQ.)
	1430	Visit diamond open pit mine
	1500	Visit Factory Number 3 (Extraction Plant)
		Bus Trip Mirny–Chernyshevski
July 30	1745	Leave Mirny
	2100	Arrive Chernyshevski
		Chernyshevski
July 31	0830	Visit Hydro-electric Project HQ and visit dam site
		Trip Chernyshevski–Mirny
July 31	1430	Depart for Mirny
	1630	Arrive at Mirny
		Flight Mirny–Bratsk
July 31	1700	Depart for Bratsk
	2015	Arrive at Bratsk
		Bratsk
Aug. 1	0915	Tour city
	1000	Visit Bratsk Forest Industrial Complex
	1130	Visit Bratsk Hydro-electric Power Station

		Flight Bratsk–Norilsk
Aug. 2	1225	Leave Bratsk
		Arrive Novosibirsk
		Arrive Podkammenaya Tunguska
	2110	Arrive Norilsk
		Norilsk
Aug. 3	0900	Visit the Medvezhi Ruchei Open Pit Mine
	1000	Visit Concentrate Plant
	1030	Visit the Power System Control Panel
	1130	Visit the Housing Construction on Lenin Prospect
	1200	Visit Kindergarten
	1230	Visit the Valek Health Centre
		Flight Norilsk–Moscow
Aug. 3	1930	Depart for Moscow
Aug. 4	0015	Arrive Moscow
		Moscow
Aug. 4	1000	Meeting with Mr. I. T. Novikov at GOSSTROI
Aug. 5		Depart for Canada

5 Transliteration Table*
This table is supplied to identify personal and geographical names.

Russian			English	Russian			English
А	а	*а*	a	Р	р	*р*	r
Б	б	*б*	b	С	с	*с*	s
В	в	*в*	v	Т	т	*т*	t
Г	г	*г*	g	У	у	*у*	u
Д	д	*д*	d	Ф	ф	*ф*	f
Е	е	*е*	e†	Х	х	*х*	kh
Ж	ж	*ж*	zh	Ц	ц	*ц*	ts
З	з	*з*	z	Ч	ч	*ч*	ch
И	и	*и*	i	Ш	ш	*ш*	sh
Й	й	*й*	y	Щ	щ	*щ*	shch
К	к	*к*	k	Ъ	ъ	*ъ*	"
Л	л	*л*	l	Ы	ы	*ы*	y
М	м	*м*	m	Ь	ь	*ь*	'
Н	н	*н*	n	Э	э	*э*	e
О	о	*о*	o	Ю	ю	*ю*	yu
П	п	*п*	p	Я	я	*я*	ya

*The system of transliteration is used by the publication Soviet Geography–Review and Transliterations.

†Instead of *e*, use *ye* at the beginning of names, after vowels and after the soft sign (').

The following simplifications have also been used:

Eliminate the use of (') and (").

Use *i* for *iy* and *y* for *yy*.
(since the maps were published earlier, geographical names were not always transliterated in accordance with this subsection.)

Convert diphthongs *ay, ey, oy, uy,* to *ai, ei, oi, ui.*

Part II General Information

6 The USSR and the Union Republics

The USSR is a federation of 15 constituent Union Republics. It was formed in December, 1922 with the original members being Russia, the Ukraine, Byelorussia and Transcaucasia (a union of Georgia, Armenia and Azerbaijan). The republics of Turkmen and Uzbek joined the Union in 1925, followed by the Tadzhik SSR in 1931. The Kazakh and Kirghiz Republics were incorporated into the Union in 1936, and in June, 1940, Moldavia and the Baltic states of Lithuania, Latvia and Estonia were added. Moscow is the capital city of the USSR and also of the Russian SSR.

Depending on the size of each Republic, all the following administrative divisions or a combination of one or more may be present: Autonomous Soviet Socialist Republics, Krais (territories), Autonomous Oblasts (provinces) with particular ethnic groups, Oblasts (administrative provinces) Natsionalny Okrugs (national autonomous areas), raions (districts), city districts, cities, workers' settlements, health-resort settlements, and village soviets.

Autonomous Republics, Autonomous Oblasts and Natsionalny Okrugs were created in order to grant certain rights to minorities within each Union Republic. There are 20 such Autonomous Republics, eight Autonomous Oblasts, and 10 Natsionalny Okrugs in the USSR[1]. The Union Republics of Russia, the Ukraine, Byelorussia, Uzbek, Kazakhstan and Kirghiz are divided into oblasts while the other republics are divided into raions.

The cities of Moscow and Leningrad constitute individual administrative units and are directly subordinate only to the Russian SSR administrative organ.

[1]Within the Russian SSR there are the Autonomous Soviet Socialist Republics of Bashkir, Buryat, Dagestan, Karbardino-Balkar, Kalymyk, Karelia, Komi, Mari, Mordovia, North Ossetia, Tatar, Tuva, Udmurt, Chechenо-Ingush, Chuvash and Yakut. Of the remaining four Autonomous Soviet Socialist Republics, Nakhichevan is in the Azerbaijan SSR, Abkhazian and Adzharian ASSR are in the Georgia SSR, while the Kara-Kalpak ASSR is in the Uzbekistan SSR. The Adygei, Gorno-Altai, Jewish, Karachai-Cherkess and Khakass Autonomous Oblasts are located in the RSFSR; Nagorno-Karakh AO is in Azerbaijan SSR; South Ossetin AO is in the Georgian SSR, while in the Tadznik SSR there is the Gorno-Badakhstan AO. All following ten Natsionalny Okrugs are in the RSFSR: Taimyr (Dolgan-Nenets), Evenk, Nenets, Ust-Ordynsk (Buryat), Koryak, Chukchi, Komi-Perm, Khanty-Mansi, Yamalo-Nenets, and Agin Buryat.

7 Responsibilities of the State Committee for Construction of the Council of Ministers of the USSR (GOSSTROI, USSR)

State committees of the Council of Ministers of the USSR are central organs of USSR administrations performing state-wide planning, co-ordination and direction of activities by various ministries and departments. Gosstroi is one such agency with the responsibility of developing basic principles for science and engineering in the field of construction and architecture in the USSR. Mr. I. T. Novikov, Chairman of Gosstroi, is also Deputy Chairman of the Council of Ministers of the USSR.

Gosstroi is responsible for increasing the effectiveness of and improving upon urban and rural construction and architecture throughout the Soviet Union. It is also charged with providing improved technical and design standards for all construction agencies in the USSR. To ensure that all building codes are observed, Gosstroi, on behalf of the Council of Ministers, supervises all construction projects and constantly reviews building codes, updating them if necessary.[2]

[2]See Appendix 1 for a detailed account of the specific duties and functions of Gosstroi.

Map 2
Union Republics and RSFSR
(Northern and Siberian areas of
the RSFSR)

--- International Boundary

-⊣⊢- Union Republic Boundary

—— Oblast and Territorial Divisions

····· National Areas

8 Soviet Development in the North

Introduction

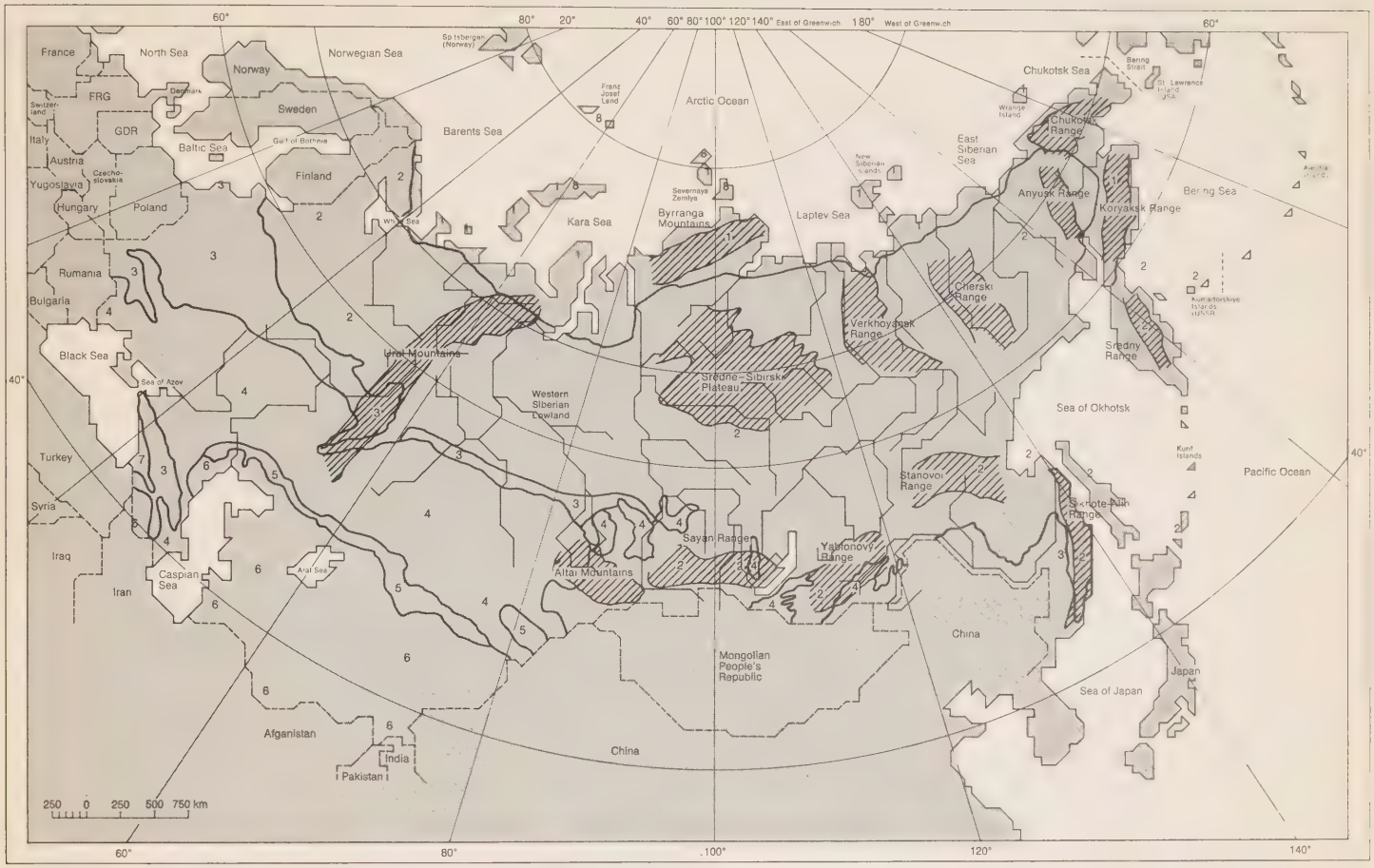
There is no general agreement by either Soviet or Western scholars as to what constitutes the Soviet Union's "Far North". S. V. Slavin of GOSPLAN, USSR. (The State Planning Committee), using economic development as his basis and population density as his primary norm, defines the Soviet North as "all that area in the north with a mean population density of less than five persons per square kilometer." According to Slavin, this would include in the European North: The Autonomous Republics of Karelia and Komi; Murmansk and the Archangel Oblasts: and the northern regions of Perm and Sverdlovsk Oblasts. In the Asiatic part of the USSR, the following areas would be included: all territory north of Tobolsk in the Tyumen Oblast; the northern region of Tomsk Oblast; all territory north of Yeniseisk in Krasnoyarsk Krai; the northern regions of Irkutsk and Chita Oblasts; Yakutia; the northern regions of Khabarovsk Krai, Magadan and Kamchatka Oblasts; and the northern part of Sakhalin Oblast.[3] This

[3]S. V. Slavin, "On the Concept 'Soviet North'." *Problems of the North.* No. 2, 1958, pp. 280-281.

Map 3
Physical and Natural Zones
(Selected Topographical Features)

International Boundary

1 Tundra
2 Taiga
3 Mixed Forest
4 Chernozem Soils
5 Arid Steppes
6 Deserts
7 Black Sea Seaboard of the Caucasus and Crimea
8 Glaciers and Continental Ice



northern zone lies only in the Russian Soviet Federated Socialist Republic and encompasses more than ten million square kilometers; roughly comparable in area to mainland Canada.

Although the Soviet North occupies almost half the territory of the USSR, it has only between 2 and 2.5 per cent of the population, or about five to six million people, of whom approximately one million are natives.[4] This is certainly interesting when one considers that north of 60° latitude in Canada there are only some 50,000 inhabitants.

[4]Terence Armstrong, *Soviet Northern Development with some Alaskan Parallels and Contrasts.* Fairbanks, ISEGR Occasional Papers No. 2, October 1970, p. 2.

Map 4
Major Mineral Development of
Siberia and the European Far North

-- International Boundary

1 Coal Mining Fields
2 Brown Coal
3 Aluminium Ores
4 Nepheline
5 Lead–Zinc
6 Gold
7 Diamonds
8 Cobalt
9 Asbestos
10 Molybdenum
11 Mica
12 Iron Ore
13 Nitrogen Fertilizers

C Copper Deposits
N Nickel
P Palladium
W Tungsten
M Mercury
Tm Tin Mines

Resources

The Soviet North is important to the overall Soviet economy because:

a) it will soon become the main power base for the country's Centre (European part of the USSR) and the Northwest; b) in spite of the relatively low level of development, the north already accounts for most of the diamonds and almost all the apatite concentrate; a large proportion of the gold, tin, tungsten, mica and nickel production, nearly half the timber logged, one quarter of the output of paper, and nearly one third of the fish catch; and c) one third of the estimated reserves of oil and gas are found in this region as well as a major portion of the potential reserves of iron ore, coking and fuel coals, and incalculable hydro-electric potential.[5]

[5] "Resolution of the Second Plenum of the Interdepartmental Commission on Problems of the North of the Council on the study of Factors of Production, Gosplan, USSR (1-3 June, 1964)". *Problems of the North.* No. 9, 1965, p. 359.

Development

Slavin states that the development of natural resources in the Soviet North can be justified economically if only one of two conditions exists:

"1 When the special value of these resources justifies the high outlays necessary for the development and exploitation; in this case the utilization of the resources in the north is economically no less effective than in other regions with more favourable climatic and transportation conditions;

2 When the resources in question are generally scarce in the country and the development is essential for the pressing need of the national economy and for strengthening military preparedness."[6]

Natural resources in the north have been developed primarily because of the latter. It is true, however, that some resources were exploited in the north because it was more economic to do so than in the south. The northeast, for example, is one of the most economical gold producing regions in the country (after the "Baleizoloto" trust), both in terms of capital investment and operational costs. Another example is the production cost of nickel on the Kola peninsula, which is the lowest in the country. Finally, the fishing and forestry industries in the north are remarkable for their economic operation.[7]

By weighing the adverse factors such as severe natural conditions, sparse population, and poorly developed transportation networks which result in high operating costs, against the exploitation of its rich natural resources, it becomes obvious that development of the north is important and necessary to the overall development of the Soviet Union. The future economic growth of the USSR will call for increasingly greater amounts of raw materials and power sources. This, in turn, will ensure that the economic importance of the north will increase substantially and directly as the developed parts of the country deplete their reserves of natural resources.

Although the push north began in the early '20s, it has only been within the past thirty years that these regions have entered a period of intensive industrial development. One positive feature of Soviet expansion in the north is the recognition that the development of these regions requires a thorough understanding of their particular natural and economic characteristics.

Soviet Planning

The north has always had a special priority in Soviet planning. During the early years, it was controlled from Moscow by two organizations: the Chief Directorate of the Northern Sea Route (GUSMP) and the Chief Directorate of Construction of the far North (DAL'STROY) which was responsible to the Ministry of Internal Affairs (MVD). From 1953, administration of the economic enterprises became the responsibility of ministries, and the north, as the rest of the country, was involved from 1957 to 1960 in a decentralization program with the establishment of National Economic Councils (SOVNARKHOZY). As the result of a general reorganization of the economic administration which occurred at the end of 1962, there was a change in the responsibility and the size of these councils and a period of centralization set in, which was completed by October, 1965, when the Regional Economic Councils were abolished and industrial ministries were established.

Research

Perhaps the most important aspect of Soviet development is the extensive network of scientific research organizations which have been set up in and for northern regions. A number of scientific institutes and laboratories of the Academy of Sciences have been established, as well as institutes and laboratories of ministries and administrative departments, planning organizations, and design offices. Vladas Stanka outlines the institutional structure of Soviet research and lists 756 Soviet scientific institutes operating in the Arctic or doing research on Arctic problems in the fields of physical, natural and the social sciences.[8]

There are also a number of scientific councils and committees formed for the express purpose of co-ordinating scientific research in the USSR and the RSFSR. One such organization is the Inter-departmental Commission for the Study of Productive Factors attached to Gosplan, USSR. Another is the Inter-departmental Commission on Problems of the North composed of scientific and planning organizations (40 in all), and ministries, departments, planning organizations, executive committees, councils of workers and other organizations (a total of 20).[9]

Although such a vast system can be at times both unwieldy and inefficient, it is worth noting that the success of Soviet development is a result of applied research and the willingness to follow the directions indicated by this research.

Relations with Native People

Relations with the native peoples of the Soviet North have generally been good, and have undoubtedly helped with its development. Dr. Armstrong feels that these "positive aspects include the provision of health services, better housing, more consumer goods, more advanced technology, and, most important of all, an extensive education program" which has, all in all, been "a very creditable achievement".[10]

[6]Slavin, S. V. "Management of the Socialist Development of the Soviet North: Methods and Forms", *Problems of the North.* No. 1, 1958, p. 247.
[7]Resolution of the Second Plenum, No. 9, 1965, p. 360.
[8]Vladas Stanka. *Institutions of the USSR Active in Arctic Research and Development* (Washington; Arctic Institute of North America, 1963) p. xi.
[9]See Appendix 2.
[10]Armstrong, op. cit. p. 30.

Map 5
Northern Increments
(based on basic monthly salaries)

-- International Boundary

1 Remotest Areas: Northern increments of 10% every 6 months until a maximum of 100% or 300 roubles a month, or whichever is least, is reached.

2 Regions of the Far North: Northern increments of 10% yearly until a maximum of 80% or 240 roubles a month, or whichever is least, is reached.

3 Localities Equated to Regions of the Far North: Northern increment of 10% yearly until a maximum of 50% or 150 roubles a month, or whichever is least, is reached.

.Although many natives occupy positions of responsibility in their own territory and there is a developing circle of native intellectuals, the majority of the native population follow their traditional pursuits of hunting, fishing or reindeer herding.[11] Undoubtedly many problems still exist in the education of native people, for Yuriy Starkach points to the need for improving their general education and vocational training. According to him more effort should be made to provide better education so that more native people could be employed in the professional and technical jobs in northern industry.[12]

Dr. Armstrong, in comparing the Soviet situation with that of Alaska, states that the Soviet Union has gone considerably further than the United States in working out relations with northern peoples. He adds, however, that "this is not surprising in view of the longer history of Russian contact with these peoples, of the greater Soviet interest in the north as a whole, of the much larger number of natives involved (nearly 20 times as many), and of the wide range of accomplishments among them".[13] In essence he attributes their success to the educational program.

In analysing the positive features of Soviet development in the north, there is no doubt that its relative success can be attributed to three major factors:

- The Soviet North is blessed with immeasureable wealth and a concentration of renewable and non-renewable resources equalled by no area in the circumpolar world.
- Soviet planning and administration of the economy in the north takes into account the unusual natural and economic features of the area. (It is true, however, that more planning is necessary since in certain areas mismanagement has occurred.)
- The attempt by Soviet planners to integrate social, scientific and technical research in solving socio-economic and technical problems associated with northern development has certainly been effective.

[11]ibid. p. 31.

[12]Yu. B. Starkach "some Questions of Economic and Cultural Construction of Small Nations of Siberia" Izvestiya Sibirskogo ot deleniya Akademii Nauk SSSR. Seriya Obshchestvennykh Nauk, No. 1. Issue 1, 1965, pp. 72-78.

[13]Armstrong, op. cit. p. 32.

Map 6
Regional Bonuses
(cost of living for isolated areas)

--- International Boundaries

Districts where the basic wage is increased by:
1 100%
2 80%
3 70%
4 60%
5 50%
6 40%
7 30%
8 20%

Note: These regional bonuses are applied to basic wages only. The maximum increase possible is 300 roubles per month.

(There still remain however, a number of unresolved problems, as witnessed by their constant reappearance in the agenda of the Inter-Departmental Commission on Problems of the North.)

In the approach to development of northern regions there have also been several shortcomings which Soviet planners are attempting to eliminate. They occurred in such areas as applied northern technology, development of an adequate transportation network, and northern agriculture. An acute problem in the 1960s was the high turnover of labour which was seen by many Soviet officials as one of the main obstacles to development of the north. In an attempt to stabilize the skilled work force in northern areas, the Supreme Soviet of the USSR published a decree in 1967 "On the Extension of Privileges for persons working in Regions of the Far North and Localities Equated to Regions of the Far North".[14] This decree, which became effective on January 1, 1968, was based upon continuing the expansion of a system of incentives initiated by earlier decrees, and to some extent upon restoring earlier incentives that had been suspended.[15] Through the use of incentive rates (*severnyye nadbavki*–northern increments),[16] which in far northern regions may be as much again as the basic wage, as well as cost of living allowances (*rayonnyye koeffitsienty*–regional bonuses),[17] which in extreme northern conditions may be equal to the basic wage, there has been a substantial reduction in the turnover of labour. Undoubtedly, material benefits will continue to be increased for workers in northern regions during the Ninth Five-Year Plan because of the success of the present program. Mr. Kosygin, in his report on April 6, 1971, indicated that regional differentials in force for wage and salary earners will be increased in a number of areas of the Far East and Eastern Siberia.[18] In addition to higher wages paid in northern regions, more attention is

[14]See Appendix 3.
[15]See Appendix 4.
[16]See Map 5.
[17]See Map 6.
[18]Directives of the 24th Congress of the Communist Party of the Soviet Union for the Five-Year Economic Development Plan of the USSR for 1971-1975. (A report by Alexei Kosygin, Chairman of the Council of Ministers of the USSR, April 6, 1971). Moscow: Novosti Press Agency Publishing House, 1971. p. 67.

Map 7
Railroads

Existing

Under Construction

Projected

International Boundary

also being paid to the need to provide workers with adequate housing, amenities and also school and pre-school facilities. There is no doubt that these measures have helped to reduce the high turnover of labour and will be one area over which Soviet planners will keep a close watch.

Applied northern technology is another area which has frequently been mentioned in Soviet publications. Since most equipment is designed for use in temperate zones, there is considerable breakage because of the intense cold and the quality of the steel. This results in excessive expenditures for repairs, estimated at two to three times more than in temperate zones.[19] The Soviet Government recognized this fact and a concerted effort was made during the past five years to provide more vehicles and equipment designed to withstand the low temperatures of the northern regions.

Today, the Soviet European North is linked to the more southern, populated regions of the country by a reasonably well developed land transportation network. Regions east of the Urals depend largely on the rivers for north-south communication, complemented in the north by the Northern Sea Route and in the south by the road and rail extension of the Trans-Siberian Railroad. It is, however, the air transportation that plays the most important role, carrying everything from passengers to oil rigs anywhere in the Siberian north. Despite the fact that the improved system of communication has greatly facilitated northern development and has helped to overcome, or at least equalize, many of the difficulties associated with living and working there, transportation still constitutes a serious bottle-neck.

With the establishment of large modern cities in the north, there has also been an attempt by the government to develop local food production. The resolution of the Expanded Bureau of the Commission on Problems of the North under the authority of the Arctic Division of the All-Union Research Institution for Crop Cultivation, on May 19, 1967, stressed the importance of developing northern agriculture. This is a highly critical area and the policy makers will be faced with the decision of either expanding agriculture northwards at great cost, or supplying northern areas with foodstuffs by air from the south, or a combination of both.

[19] V. P. Loginov *et al*, "Problems of Increasing the Efficiency of the Economic Development of the North". *Problems of the North*, No. 9, 1965, p. 110.

Conclusion

It is obvious that Soviet development of the north is expensive, costing three to four times more than in more temperate regions. Most capital invested in the development of natural resources is spent on the construction of roads and transportation facilities, power stations, auxiliary enterprises, cultural and public services, and housing. The planners and policymakers have been prepared to pay this high price and have certainly been successful in certain areas, especially in the creation of huge northern cities. In the European Far North there are: Archangel (318,000), Kotlas (61,000), Monchegorsk (53,000), Murmansk (307,000), Petrozavodsk (181,000), Severodvinsk (129,000), Syktyvkar (132,000), Vorkuta proper (65,000; or 188,000 including surrounding settlements). In Eastern Siberia, there are Magadan (88,000), Noril'sk proper (133,000; or over 155,000 including surrounding settlements), and Yakutsk (104,000).[20]

The Soviet government is rightly proud of its achievements, but Soviet officials also admit that more work is necessary, especially in the areas of: improving living conditions in the north; raising the level of the economy, culture, and living conditions of the native people; carrying out regional planning of cities and settlements; improving on construction techniques; establishing a precise technical and scientific policy for northern regions and northern conditions; providing and supplying production and consumer goods needed in the north; and improving the agricultural and hunting economy of the far north.

[20]See Appendix 5.

Part III Discussions in Moscow and Leningrad

Moscow

9 Meeting at the State Committee for Construction USSR (Gosstroi)

Present at the meeting were:

Ganichev, I. A.
Vice-chairman of Gosstroi

Yermolenko, V. G.
Chief, Foreign Relations Department

Krivenko, P. N.
Assistant Chief, Foreign Relations Department

Sadovski, B. A.
Foreign Relations Department

Volnyanski, E. R.
Chief, Department of Construction

Semenov, V.
Ministry of Foreign Affairs

Kuzin, N. A.
State Committee on Science and Technology

Antonov, A. F.
Lenzniiep

The chairman of the State Committee for Construction, USSR, is Mr. I. T. Novikov who is also the Deputy Chairman of the Council of Ministers, USSR. Gosstroi is responsible for construction in the Soviet Union, especially in matters of establishing standards for construction, of supervising construction, and of directing work at research institutes directly under it and under each of the 15 republic Gosstrois.[21] This organization is also responsible for co-ordinating the efforts of 10 separate, all-union ministries which are involved in some aspect of construction. Six of these ministries are directly concerned with construction, while three have construction as one of their prime functions in addition to others. The remaining ministry is that of gas, and is responsible for the construction of all pipelines in the Soviet Union.

Of 10 million workers in the construction industry, there are approximately 150,000 engineers, architects, designers and skilled scientific research workers employed at various levels in the Gosstroi Administration. Thirty thousand of them work primarily on scientific research while the remaining 120,000 are employed in the engineering and designing aspects of construction.

The Soviet North occupies a vast area and it is estimated that 40 per cent of the country is above the 60th parallel. This region divides roughly into four separate zones: European North, Western Siberia, Eastern Siberia, and the Far East. Within these zones there are two climatic sub-zones; Arctic and sub-Arctic. Permafrost may extend from a depth of 25 meters to over 1,500 meters, and winter temperatures usually drop to below minus 40 degrees centigrade. In some areas of this region there are 350 days of sub-zero temperatures and it is necessary to provide heat throughout the entire year. Snow drifting also adds to the hazards of building in the north. In addition to the natural difficulties, the psychological effects of working under such extreme conditions, with three months of darkness during the winter, are at times more serious and difficult to overcome.

Higher costs are common in the north and construction costs are greater by as much as two to eight times, varying with latitude, than for similar construction in European Russia. Thirty per cent of this increased cost is the result of coping with the severe natural conditions and 70 per cent is the result of such economic factors as fuel, transportation, and manpower.[22] Gosstroi's budget for construction in this region is broken down as follows: 12½ per cent for Western Siberia, 14 per cent for Eastern Siberia, and 23 per cent for the Far East.

Mr. Chrétien read a prepared statement in which he stressed the necessity of increasing exchanges with the Soviet Union on matters relating to the north.[23] In particular the greatest benefit would be realised by exchanges between Gosstroi and the Department of Indian Affairs and Northern Development on (1) the design, construction and operation of buildings and other structures on permafrost; and (2) the development and disposition of northern industrial and transportation networks.

[21] See Section 7 and Appendix 1 for an outline of Gosstroi's responsibilities.

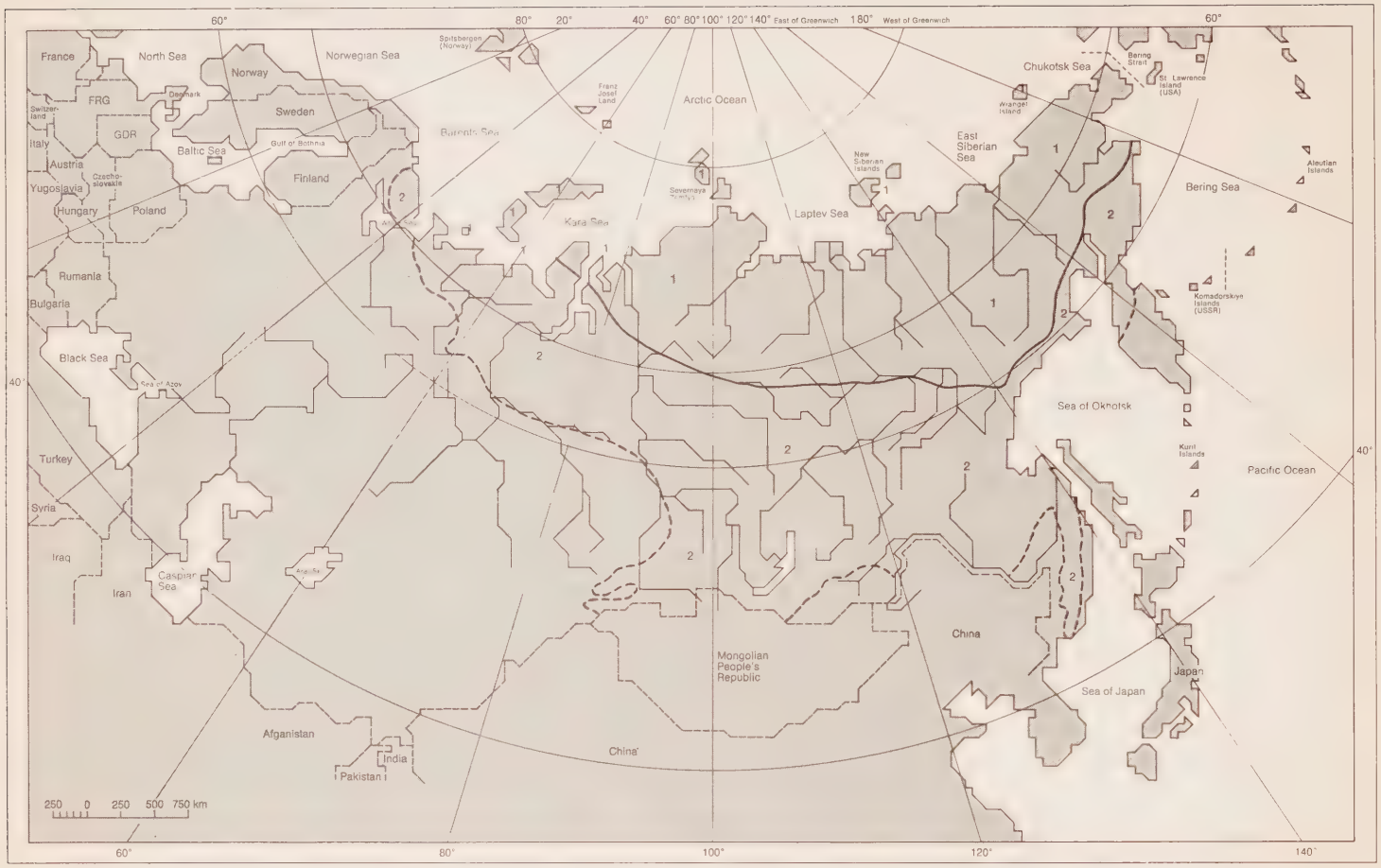
[22] See Maps 5 and 6 in Section 8.

[23] Appendix 6.

Map 8
Permafrost Regions

1 Continuous Permafrost Zone
2 Discontinuous Permafrost Zone

----International Boundary



In following the expansion of the Soviet North he expressed particular interest in the successes and failures of the Soviet Government in developing local government, community structure, education, housing, indigenous culture, natural resources, and the gas and oil industry. Mr. Chrétien explained to his Soviet hosts that his responsibility included not only industrial development north of the 60th latitude in Canada, but also the social and cultural development of all Eskimos and Indians, as well as providing adequate national parks for Canada.

10 Visit to an apartment building

There were several apartment buildings being constructed at the site selected ranging from five to 16 floors. The 16-floor building contained two-, three-, and four-bedroom apartments, and housed 275 units.

Construction

The building was constructed on precast concrete piles because of unstable soil conditions in this particular area. The exterior panels were concrete curtain wall composed of aedite (light concrete) with good insulation qualities. No other insulation was used in the building except perhaps in the roof.

Wallpaper was used as an interior finish and floors were covered with a wooden v-pattern type of parquet flooring (size of each slat 2″ x 12″). The kitchen floor was covered with linoleum. Plans showed an expansion joint at the centre of the building, but apparently during construction the design was changed. It was felt that, since the curtain wall panels had sliding joints, an expansion joint was not necessary. Apparently other buildings were similarly constructed and the project engineer stated that they had not experienced any problems.

All prefabricated elements were manufactured in a factory, and most apartment building designs were standardized and used throughout the city.

2 Construction site visited in a suburb of Moscow.
3 View of the entire project.
4 Exterior pre-cast concrete panels.
5 Sixteen-storey apartment building under construction.
6 Floor plan of one-bedroom apartment. Each apartment has a balcony, living room, dining area, bedroom, kitchen and bathroom.

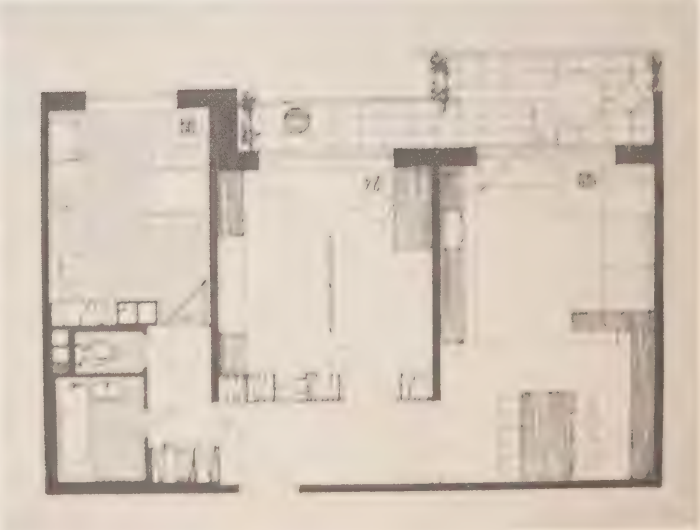
2

3

4

5

6



11 Meeting at the Council of Ministers of the Russian Soviet Federated Socialist Republic

Present at the meeting were:

Demchenko, V. A.
First Deputy Chairman of the Council of Ministers, (RSFSR)

Drozkov, D. M.
Chief of Special Department in Council of Ministers on the Economic and Cultural Development of Northern People.

Introduction
The Russian Republic occupies a territory of approximately 70 million square kilometers of which 64 per cent may be termed northern. The population of the Republic, according to the 1970 census, was approximately 130 million, of which only five million lived north of the 60th parallel. There are 72 administrative regions including autonomous republics, oblasts, national okrugs, and territories, together with a 73rd administrative district which is the city of Moscow. Although the population in the northern area is made up of multi-national groups, the greatest proportion are Russian, Ukrainian, and Byelorussian. There are three major indigenous groups—the Yakut, Karely, and Komi, and a number of smaller groups such as the Evenks, Nentsy, Khanty, Mansi, Evens, Nanaitsy, Koryaks, Yukagirs, Chukchi, Eskimo, and others. In all, approximately 26 different native groups are found in the Russian Republic, of which over 20 are in northern regions.

Part of the northern region is made up of the Yakut Autonomous Soviet Socialist Republic with a population of 667,000, of which 300,000 are Yakut. The other two Autonomous Soviet Socialist Republics found in the north are Karelia and Komi.

The population increased during 1959 to 1971 by 16 per cent in the Republic as a whole, as compared to a 25 per cent increase for the native people. The Eskimo population increased to 1,625 or by 14 per cent for the same period.

Native People
Although most members of each indigenous group speak their own language, the majority are also fluent in Russian. Some work in government, industry, and such professions as medicine, teaching and administration, but they are primarily engaged in the traditional pursuits of hunting, fishing and reindeer herding. Native people enjoy all the same privileges as a Russian, including the special northern increments and regional bonuses which as mentioned before, may be as much as the basic salary.[24]

Reindeer Herding
One of the most important industries in the Soviet North is reindeer herding and breeding. There are 2½ million domesticated reindeer in the north, as well as approximately 700,000 wild deer, which are found mostly in the Magadan and Kamchatka regions. Twenty-five thousand tons of meat a year are produced and consumed locally except for meat sold by specialty shops in other parts of the USSR. More meat is needed in the north, however, and it is shipped from southern regions. Hides are shipped primarily to Irkutsk to be tanned.

A major problem in reindeer herding is the lack of pasture and it is necessary to limit breeding. If acreage for grazing can be increased, the reindeer population can be raised to as much as five million head.

There are 10,000 workers in the reindeer breeding industry with the greatest number employed as herders. Income, including northern increments and bonuses, can vary from 200 to 400 roubles a month. Basic earnings range from 120 to 130 roubles a month and, in addition, each herder receives free clothing and meat at cost.

Reindeer herders are being converted to part-time nomads. They follow their herds for a two-month period and then spend the rest of their time in villages working on state farms, construction, or on their own small private plots of land.

Hunting, Trapping and Fishing
There are between 10,000 and 12,000 hunters who combine hunting with trapping, fishing, and fur farming. From November to February these people are engaged in hunting and trapping, while fishing becomes their chief occupation during the spring and summer. Hunting, fishing and trapping are regarded as being a profession and individuals are paid a basic monthly wage.

The guaranteed minimum income is between 100 and 120 roubles a month. A bonus is paid to trappers and hunters for whatever they catch in excess of the established norms.

Ermine and fox are hunted in the more southerly areas of the northern region, while mink, white fox, and sable are hunted in the northern areas. At present, blue arctic fox is being bred by the fur farmers.

[24]See Section 8.

Map 9
Ethnologic Map of Siberia

--- International Boundary

A Russians
B Ukranians
C Lapps (Saams)
D Komi
E Khants
F Mansi
G Nentsy
H Nganasans
I Entsy
J Selkups
K Kazakhs
L Tartars
M Altais
N Khakasy
O Shors
P Tuvans
Q Tofalars
R Yakuts
S Dolgans
T Buryats
U Evenks
V Evens
X Negidals
Y Nanays
Z Kets
a Oroks
b Udegeis
c Orochi
d Eskimos
e Yukagirs
f Chukchi
g Koryaks
h Itelmens
i Nivkhis
j Aleuts
k Ulchi
m Jews

The fishing industry plays an important role in supplying work and food for local inhabitants. Although the fish are primarily for local consumption, salmon and sturgeon are sold commercially. Off the coast of Chukotka, Tyumen, and Archangel, such large mammals as seal, walrus, and whales are also hunted.

Agriculture

It is possible to raise most dairy products in northern areas and, in addition to reindeer meat and fish, cattle and chickens are a source of meat. It was reported that in certain parts of the north there are as many as 150 cows and 5,000 chickens on a single sovkhoze. It is necessary to bring beef and other foodstuffs from southern regions, although imports are kept to the bare minimum because of the high cost of transportation.

Wages

In the kolkhozes (co-operative farms) and sovkhozes (state farms) each hunter is paid a monthly wage. The minimum is usually between 100 and 120 roubles which can be doubled or tripled when one adds the northern increment and regional bonus. A hunter who exceeds his quota of animals caught is paid accordingly. To ensure the greatest possible productivity:

–a control is provided by other hunters;
–a program of incentives is used (the more you catch, the more you get);
–the hunter is regarded as a professional man.

The hunter and trapper usually make more money than the reindeer breeder and herder.

The average income in the north (for a herding family of four to six persons, with usually two persons working in a sovkhoz) would be approximately 7,000 roubles a year. On the other hand, a family of two working in a kolkhoz would earn approximately 4,000 roubles a year. In addition, a family working in the kolkhoz can keep 25 to 50 reindeer as its own property in order to earn extra income.

Income can range from a minimum of 130 to a maximum of 1,000 roubles a month for hunters and trappers.

Education

The educational system has been successfully extended to most northern settlements. There are boarding schools at which children may stay for the entire academic year or weeks at a time, depending on the occupation of the father and mother. Eight grade schools teach all subjects in native languages up to the sixth or seventh grade, after which instruction is given in Russian. It appears that parents can choose the language in which their child will be taught. Often it is necessary to send children in grades nine and 10 to larger communities in order to prepare them for university. Education is paid for entirely by the state. It is possible for indigenous students with a "C" passing grade to be admitted to university, without entering a competition, as is compulsory for all others. This means that they could be admitted to university, if they pass their final examinations, with lower marks than other applicants.

Health, Welfare and Culture

Nomads are being encouraged to join settlements. From 1952 to 1970, 12,000 families, or between 52,000 and 75,000 persons, were settled in villages or towns.

Medical care is free, and to encourage local population growth a bonus of 150 roubles is paid upon the birth of the first child. In addition, if an individual wishes to build his own home, 75 per cent of the cost is paid by the state.

The preservation of local culture is important. The government supports local newspapers and radio stations, and cultural activities are conducted in local languages. There are TV stations in four regions offering local programs as well as material relayed by the ORBITA satellite. A special school of Eskimo dancing for children has been established in Chukotka.

Native people are encouraged to participate in the political life of the RSFSR and the USSR.

*Questions**

1

According to Slavin there is a high turnover of labour which is detrimental to development in the Soviet North. What have you done to stop this high turnover?

A

The 24th congress has stated that there will be a standardization of amenities in the north and incentives will be increased. At present, according to the 1968 decree, it is possible for individuals working in the north to earn from the minimum of 140 roubles a month to a maximum of 1,000 roubles a month.

2

What is the greatest problem in developing the north?

A

The small population of the north detracts from its development. Other immediate difficulties are the need for increasing the size of the reindeer herds, improving transportation and communications, and providing adequate food.

3

How much oil is being pumped out of the Tyumen Oblast?

A

At present 30 million tons of crude oil are produced yearly. This will be increased by 1975 to 120 million tons of oil from Surgut (Tyumen Oblast) and 200 to 250 million tons by 1980.

4

Do you have any problem with alcoholism in the north?

A

The situation appears to be better than in Moscow. Even with the overproof spirits that we have in northern regions, there seems to be less absenteeism than in southern regions.

5

Are there any problems between the native population and the white population?

A

There may be some minor problems of the whites being jealous that the native people get too many advantages, but this certainly is a very minor irritant and, generally speaking, there is very little social friction between whites, especially new arrivals, and natives. There is considerable inter-marriage between Russians and native peoples.

6

Are there special laws governing native people, especially in the administration of justice?

A

On the administration of justice there are local courts applying a uniform law, with the possibility of appeal to the RSFSR and USSR supreme courts. Native customs are not taken into consideration in passing sentence.

*At the conclusion of the meeting it was found useful to record conservations with our Soviet hosts in a question and answer format. It should be noted that this is not a recorded transcription of actual dialogue, but that it represents a report of the basic elements of inquiry and reply, as these were understood by the writer. This type of format is used throughout the report.

12 Meeting at the Committee on Science and Technology, USSR

Present at the meeting were:

Yefremov, B. A.
Deputy Chairman.

Kuzin, N. A.
Head of the Department of Foreign Relations with Advanced Countries.

Mr. Yefremov approved of the exchange of information in the areas of science and technology. He agreed that exchanges at a high level coincided with the Soviet point of view and that they could include:
- exchange of technical information;
- exchange of delegations, such as Mr. Chrétien's, to further better relations;
- exchange of experts and scientists.

13 Meeting at the Ministry of the Gas Industry

Present at the meeting were:

Sidorenko, M. V.
First Deputy Minister.

Sorokin, A. I.
Deputy Minister.

Zinevich, A. M.
Director of the Research Institute concerned with the Construction of Pipelines.

Aleksandrov, A. V.
Chief of the Engineering Department.

Muzhilivski, P. M.
Chief Engineer of the Gas Transmission Department.

Kortunov, V. A.
Chief Engineer at the Construction Department.

Takhenko, R. O.
Assistant Chief of the Foreign Relations Department.

Konovalev, V. A.
Chief Engineer at the Gas Production Department.

Volski, E.
Secretary of the Mixed Commission Working Group on Gas.

The ministry of the Gas Industry, employing approximately 400,000 persons, is engaged in the production and distribution of gas: the development of machinery for pipeline construction, the drilling of development wells in oil fields, and the construction of all gas and oil transmission pipelines in the USSR. Pipeline construction forms the major part of the work done by the ministry and approximately 60,000 kilometers of pipeline have been built.

Present policy is to construct larger diameter pipelines such as the 1,424 mm (56 inches) pipeline operating at pressures of up to 75 atmospheres. This pipeline is planned to run from the Tyumen area to the Centre (European part of the USSR) and on to the East European countries and West Germany. Pipelines currently in use are 1,020 mm (40 in.) and 1,220 mm (48 in.) in diameter.

The ministry is also responsible for the design of pipeline equipment and compressor units for pumping gas. Turbine compressor units of 10,000 to 16,000 horsepower are being planned.

Gas production for 1970 was estimated at 200 billion cubic meters, while the 1975 projection is for 320 billion cubic meters. Between 25 and 30 per cent of the gas is used by thermal generating stations having an installed capacity of 3 million kilowatts.

Map 10
Oil and Gas Industry–1970

▾ Settlements
---- International Boundary
—— Gas pipeline in use
– – Gas pipeline under construction
—•— Gas pipeline planned
—— Oil pipeline in use
– – Oil pipeline under construction
—•— Oil pipeline planned
☼ Oil bearing regions
• Oil producing regions
◦ Gas bearing regions
◦ Gas producing regions

Soviet pipeline policy provides for looping lines to ensure an uninterrupted supply of gas. In addition, underground storage is generally provided closer to the market.

The ministry is doing research on liquified natural gas, the gasification of oil, and the design of machinery for constructing pipelines. Pipelines already built on permafrost are considered to be experimental and underdeveloped. One gas line built on permafrost is in Yakutia and runs from Tas Tumus to Yakutsk and on to Pokrovsk. A second will soon be operating from the Messoyakha gas field to Dudinka–Norilsk–Talnakh. Most of the lines in the Tyumen Oblast are across the swampy lowlands.

There are no major pipelines under water, except for an eight-kilometer oil line from the mainland to Sakhalin Island in the Far East situated at a depth of 30 to 40 meters. There is a proposal for a pipeline to be built from Sakhalin to Japan, but this is only in the planning stage. Severe climatic conditions increase the cost by 30 per cent and transportation raises it a further 70 per cent. Temperatures of minus 40 degrees centigrade are usual, with below zero temperatures occurring for 305 days of the year.

14 Meeting at State Planning Committee, USSR (Gosplan)

Present at the meeting were:

Baibakov, N. K.
Chairman

Nekrasov, N. N.
Director of the Institute of Productive Forces

Pervoukhin
Director

Spandaryan
Chief

Siberia is most important to the economy of the USSR and possesses large energy reserves including 80 per cent of all oil and gas, coal, and water power. The Ust Ilim hydro-electric project alone will provide four million kilowatts, while installed capacity of the Bratsk hydro-electric station amounts to 4.1 million kilowatts with an annual electric power output ranging from 21 to 25 billion kilowatt-hours. Siberia is also the centre of the greatest pulp, paper, and lumber industry in the world, and leads in the reserves of gold, copper, nickel, platinum and diamonds.

New polymetallic ores have been discovered in Siberia, and the Mirny, Udachnaya and Aikhal diamond mines have been developed at an investment of ½ billion roubles. These diamonds are used for jewelery, instruments, and industrial purposes.

To develop industries in northern regions costs half as much again as in other regions: the cost of similar development in southern Siberia is 20 to 30 per cent higher than in other parts of the Soviet Union. The high cost is due primarily to the permafrost and also the extreme temperature variations and high winds. Other contributing factors are the need to supply improved living conditions, such as housing, cultural activities, amenities, and higher wages to workers. Higher pay—as much as twice that paid in southern regions—along with certain cultural advantages, have been helpful in controlling if not completely eliminating the high turnover of labour.

In 1970, the Tyumen Oblast, with an area of two million square kilometers, produced 42 million tons of oil from 100 producing fields. This year's quota will increase to 60 million tons, and by 1980 it will be 125 million tons.

Present policy is to produce gas from the less remote areas found in the Tyumen Oblast; that is, in the areas of Surgut and Ob River, while doing exploratory work in regions farther north for future use. Seven million cubic meters of gas are produced from this region and are used primarily in the central regions of the Soviet Union. The pipelines now in use are 1,020 mm (40 in.) and 1,220 mm (48 in.), while a larger pipeline of 1,424 mm (56 in.) is planned for 1973. This pipeline will run 2,600 kilometers along the northern route through to Leningrad and Moscow, and then be extended for another 1,500 kilometers to the southwest to the Socialist Countries and West Germany. It will be constructed both above and below ground and specifications will call for pipe designed to withstand temperatures as low as —60 degrees centigrade. This pipeline will require greater rigidity since deformation will cause cracking because of its large diameter. Special laying procedures have been worked out based on the experience at Yakutsk and Norilsk.

To date, all information is based on experience with the 600 kilometers of pipeline constructed on permafrost. Although problems are expected with pipelines, the Soviet engineers are confident that they can be overcome. For the construction of pipelines on permafrost, lines may be buried in berms of earth on the ground or on elevated structures with rollers to take lateral movement.

Ice roads are used in the Tyumen Oblast in which the upper part of the soil is removed and the sub-soil is allowed to freeze. The frozen ground is then covered with logs and sand which creates a local permafrost condition that will not thaw in the summer. Drilling sites for wells are prepared in swampy areas in a similar fashion. A single drill site with six or eight directional wells will produce one million tons of oil a year.

It is possible that exploration will be extended to the Arctic Ocean because geological formations indicate the presence of oil and gas. No drilling has been undertaken in the Arctic Ocean, however, since ample areas are available for exploration in the southern regions. Markets are increasing and, if additional production is required, it is quite possible in the near future that the Russians will extend their exploration to include northern seas, in spite of the fact that such operations will be difficult and costly.

The southern regions, especially the region of Baku, provide 11 millions tons of oil annually from beneath the Caspian Sea using platforms and elevated roads built across the sea.

The USSR intends to become a leading exporter of oil and gas. There is no immediate worry about depleting their reserves because:

- There are proven reserves of gas and oil in the USSR sufficient to last for this century at least.
- Thereafter, atomic energy will probably be the chief fuel. Economic atomic powered stations can produce one million kilowatts. At present atomic powered generators in the Soviet Union are producing a total of 440,000 kilowatts of electricity.
- Proven reserves of coal run into trillions of tons which, if necessary, could be used as such, or could be gasified.
- Furthermore, to meet internal and external commitments they are also considering importing oil.

The next five years will see more gas pipelines being built. Unfortunately, gas fields are situated far from the central (European) region and the cost of transportation from northern Siberia is high. On the other hand, it is more economical to transport gas from the southern than the northern fields. For example, the length of the pipeline from the Tyumen Oblast and from Central Asia, particularly Turkmenstan, to the central region is approximately 4,000 kilometers. It is, however, 25 to 30 per cent cheaper to construct the pipeline from Central Asia to this region. Moreover, the period of construction is much shorter for southern pipelines because they are built on a year-round basis, while in northern regions the permafrost and severe weather conditions limit construction. Construction of a pipeline in the north, the high cost of building materials and labour, in addition to time lost because of weather, lead to greater costs and delays. The main objective of the present five-year plan, therefore, is to maximize the use of gas available from the southern regions of the Soviet Union.

The present five-year plan has listed, in order of priority, the expansion of the gas industry:

- To meet immediate needs for European Russia by exploiting oil and gas deposits in Central Asia.
- To meet growing needs, plus foreign exports, and also supply the Urals from the Tyumen area.
- To develop the northern gas and oil fields for use at a future date.

This program is in effect now. A limited amount of money has been given to the Ministry of Gas and it is therefore necessary for the ministry to develop lower-cost sources, i.e. Central Asian exports, initially. With regard to the development of non-ferrous minerals, such as diamonds, aluminum, nickel, and copper, however, these resources will be developed in Siberia since most of them are found only there. Coal will not be taken from Siberia because it is not economical to do so.

Oil and gas will be the main fuels developed because it is cheaper to transport them by pipeline and because they are more efficient than coal. For the same amount of power you require 45 million tons of oil and more than 60 million tons of coal, which then has to be shipped by barge or railway car. Gas and oil are, therefore, greatly preferred over coal because the cost of production is 1/15 the cost of coal and transportation is four times cheaper. A pipeline having a diameter of one meter will deliver 10 to 11 billion cubic meters of gas a year; equal to about 45 million tons of oil or 60 million tons of coal.

Coal-fired, thermal generating stations are being constructed, however, especially in regions where there are great reserves of coal. This year millions of tons of coal will be delivered to the Urals to power two 4,000-kilowatt stations. This coal is usually mined using the open pit technique, a method which involves removal of some 45 million tons of rock a year in Siberia and results in destruction of the landscape. To reduce damage to the environment, government policy is to landscape and reforest the area after the coal has been removed.

A 1.5 million-volt transmission line is proposed, to transmit electricity from the north to the Centre instead of constructing railroads to carry the coal. This will have the effect of protecting the ecology and also be more economical.

Part of the Yakutsk gas line is on piles, part is buried, and a part is laid on the tundra and covered by earth. Natural well pressure is 50 atmospheres, sufficient for delivery. No compressor is used on the pipeline because it is relatively short and it is considered more economical to loop the line. On a longer line, compressors would be situated at 100-kilometer intervals operating at pressures of between 50 and 70 atmospheres. It was recognized that in this particular instance the gas would have to be cooled to avoid thawing of the permafrost.

There was a brief comment on the production of electrical energy directly from gas using a magnetic hydrodynamic convertor which produces electricity by shooting an ionized gas through a magnetic field.[25]

At this point a question was asked about the regional breakdown of the Soviet Union.

The USSR is divided into 19 economic regions: 10 in the Russian Republic, three in the Ukraine, three in the Baltic Regions, one in the Caucasus, one in the Central Asian region, and one in Eastern Siberia, with special recognition given to Siberia and the Far East. There are 25 million people living in Siberia and the Far East with a growth increment of four million people in the last ten years. The majority of these people live in the southern part of Siberia. In the USSR there are 10 million square kilometers north of 60 degrees latitude with only 3.9 million people living east of the Urals in this region, and another one to two million people living in the European far north.

Siberia is developing at a rate 20 per cent faster than the rest of the country and it is twice as expensive to develop resources in the extreme north than in the south. Transportation, especially by rail is approximately 15 to 20 per cent higher in northern regions.

Plans call for the export of 27 billion cubic meters of gas by 1975 of which 23 billion cubic meters will go to the Socialist Countries, West Germany and Italy. The Soviet Union presently imports 10 billion cubic meters of gas from Iran and 2½ billion from Afghanistan.

[25]See Section 16.

Questions

1
What other products do you get from your nautral gas?

A
Non-associated gas is said to be 99 per cent methane. No other products are obtained from the gas. On the other hand, a casinghead gas from oil wells is a source for ethane, propane, and butane which are used for heating and for some chemical manufacture.

2
You stated that you have great need for your oil and gas products and yet at the same time you are exporting these products.

A
Well what are you doing? We have no worries, our reserves are plentiful and more are constantly being found. Perhaps in the future atomic energy will replace fossil fuels and will be cheaper. Our present five-year plan includes the development of atomic power.

3
Northern development is more expensive. Does this hold you back in the development of your north?

A
Let's talk about it. The main direction of this five-year plan is to extract more in the southern areas since it is more economical. For example, as I mentioned earlier, the cost of a similar length of pipeline is 25 per cent cheaper in the south than in the north. Moreover, it is more easily and more quickly laid and you can work the whole year round. In the north the number of working days is reduced and there are the long winter nights. From an economic standpoint we are always arguing that we must develop industries. As a state planning committee responsible for finances, we do not want to invest money without demanding good return on our investments from the ministries.

4
You stated that for the extraction of coal the open pit method of mining is used. What about the environmental scars on the earth?

A
Do you think that the earth can remain virgin forever? What about a man who has an operation? A scar remains but he functions as well as or better than before. We certainly try to avoid wanton destruction and after the coal has been removed the entire area is cleaned, and there is a program of reorganization of the landscape and reforestation.

15 Meeting at the Ministry of the Oil Industry

Present at the meeting were:

Shashin, V. D.
Minister of Oil Industry

Orudzhev, S. A.
Vice-Minister of Oil Industry

Takoev, D. A.
Deputy Minister of Oil Industry

Filanovski, V. Yu.
Chief Construction Department

Arushanov, P. A.
Department Head

Knysh, L. I.
Senior Engineer, Protocol Department

The Ministry of the Oil Industry extracts all the oil in the USSR together with 25 to 30 per cent of the gas. This Ministry, in co-operation with the Ministry of Geology, is involved in geological work, exploration and development drilling, oil surveys in foreign countries, and the extraction of oil.

There are 25 institutes under the ministry which carry out research on the transportation of oil by pipeline and design gas manufacturing facilities. The Ministry employs 600,000 people and drilling amounts to 35 million metres a year.

Half of the USSR is a sedimentary basin of which 12 million square kilometers is on land and 2½ million square kilometers is on the continental shelf to a water depth of 200 meters. Islands off the Arctic Coast do not appear to be sedimentary, although Soviet maps indicate sediments in adjacent areas.

All oil is moved by pipeline or railroad. There is an experimental gas pipeline on permafrost but, as yet, no oil pipeline. Although the Ministry has no experience with long-distance transmission of gas and oil on permafrost, it does have experience in small oil-gathering systems laid in permafrost and also the gas pipeline at Yakutsk.[26]

Strange temperature phenomena have occurred in drilling. At a depth of two kilometers, in one instance, the temperature was 25 to 35 degrees centigrade when ice was encountered. Earthquakes have not broken pipelines, but landslides have occurred and these have caused problems. Earthquakes occur primarily in the Caucasus, but the pipelines are of small diameter and only minor problems have been encountered.

In the Tyumen region all drilling is done in the winter because the land is generally low-lying. The distance from the oil and gas fields in the Tyumen Oblast to the Arctic Ocean is 2,500 kilometers. The difference in elevation is only 100 meters resulting in the entire area being

[26]See Map 10.

covered with swamps and bogs. Drilling platforms are made by removing soil and swamp water and permitting the ground to freeze: it is then covered with logs and sand. A second layer of logs and sand create a permafrost island 200 meters square, from which a number of development oil wells are drilled.

Oil line pumping stations are 99 per cent electric powered and operate at pressures of 55 atmospheres.

In looking at new modes of transportation in northern areas, it was stated that there are non-involved enthusiasts who consider the use of dirigibles to move oil in the north, but actually this means of transportation is not being considered by the ministry. There is experimental work on the use of air cushion vehicles (ACV) for drilling rigs and for transportation. It is, however, the conventional transport, such as helicopters and aircraft in initial drilling operations, trucks and tractors and tractor trailers hauling equipment and supplies over winter roads, and the river transport and pipelines, that play the greatest role. A railway is now being built from Tyumen to Surgut as the final link.

Questions

1
We know that you have gas pipelines operating on permafrost. Do you have any for oil?
A
No. We soon will initiate studies on the large-diameter pipelines carrying oil in permafrost conditions.
2
How do you transport people?
A
In Siberia we have many rivers and consequently we make use of them. Primarily we move about by aircraft, but this varies from ministry to ministry. Next year we will be producing 17 million tons of oil. We expect to increase this to 25 million tons a year. As we develop this resource, more support from planes and helicopters will be required. In remote areas the helicopter will be mostly used for men but not for equipment. In the Tyumen Oblast we are setting up five settlements for permanent workers where they will travel five to 30 kilometers to their work site. In all, there are approximately 35,000 people involved in drilling for gas and oil, including construction and extraction workers.
3
Have you found oil in the far eastern region?
A
We did some initial work which is now being carried out by the Ministry of Geology. While some discoveries have been made, nothing of importance has yet developed.
4
Have you looked at using balloons for transportation in northern regions?
A
No! Have you? We use helicopters in construction sometimes.
5
Do you move your oil by rail?
A
Yes, but pipeline is cheaper.
6
How do you move your pipe in?
A
By water. We move our drilling rigs in winter.
7
Do you lay railroad on the winter ice?
A
We are building some 700 kilometers on permafrost. No, we do not build railroads on winter ice. We do, however, make winter roads for trucks on ice.
8
Where is your pipe produced?
A
In the Urals.
9
Do you use hovercraft?
A
Yes, but such use is in the experimental stage and we are only looking at it now.
10
We only drill in winter because of the problem of moving equipment. What do you do?
A
We work all year round, but in summer we prepare for winter. In the north we prepare during the winter for drilling in the summer.
11
On your artifical permafrost islands, how many wells do you drill?
A
Up to 20.
12
Do you have oil tankers moving across the Northern Sea Route to deliver crude oil to the eastern coast?
A
No. We do not ship oil in the Arctic.

16 Visit to the Magnetic Hydrodynamic Convertor (MHD)

(Notes prepared by Mr. Lowe)

On August 4 the MHD Experimental station was visited. At present the output of this plant is 3 megawatts electric. Power is generated by passing a very high temperature plasma through a magnetic field provided by an electromagnet. Electrical energy is extracted without benefit of any moving parts such as generators. Oxygen and natural gas provide the heat source at this plant, situated just outside Moscow. Pressure in the gun is 25 atmospheres, and the temperature is 3,000 deg. K. A system of cooling pipes maintains the inside wall temperature at 350 deg. Seeding material on the plant was $K_2CO_3+H_2O$. Efficiency of the plant is about 1.5 per cent. A larger installation of the same type is being built with a design efficiency of 15 per cent. Our hosts indicated that with a more efficient seeding material, such as cesium, and better electromagnets, a design efficiency of 65 per cent would be possible in the future. This would, of course, mean twice the efficiency of modern thermal plants.

Leningrad

17 Visit to the Arctic and Antarctic Institute[27]

Present at the meeting were:

Korotkevich, Ye. S.
Acting Director

Tyabin, N. I.
Deputy Director

Baskakov, G. A.
Department of Oceanography

Smirnov, V. I.
Ice Navigation Studies Department

Sokolov, A. L.
Sea Ice Forecast Department

The institute was founded in 1920, and celebrated its 50th anniversary in 1970. There are approximately 1,800 people employed in the institute in such areas as meteorology, oceanography, magnetics, geophysics, ice forecasting, aviation and logistics.

In the past they have operated 100 polar research stations mainly for weather information, and now have four stations operating together with 20 DARMS (Drifting Arctic Research Meteorological Stations). In addition, the institute operates expeditionary and research ships in the North Atlantic and Antarctic which provide primarily long- and short-term weather forecasts, and reports on ice conditions. Information is gathered and co-ordinated for the operation of the Northern Sea Route each year.

Work done in the institute is important for the development of the Arctic and the Antarctic. All work for other groups is co-ordinated by this institute, and in the Antarctic there are several stations, such as Mirny and Vostok, which are supported by it.

The budget of the institute is approximately 10 million roubles, divided as follows:

- 30 per cent for meteorological work;
- 45 per cent for oceanographic studies;
- and the remaining 25 per cent on a combination of such other studies as magnetics, geophysics, aviation, and logistics.

[27] See Appendix 7. Chronological description of the Arctic and Antarctic Institute is provided by Vladas Stanka.

Questions

1
Are you hoping for all-year sea transportation in the Arctic?

A
It is technically possible, but is it economically feasible? We are certain that powerful ice-breakers could keep the Arctic Ocean open.

2
Do you believe it necessary to move Arctic resources through the Arctic?

A
We are already doing this within the Soviet Union. We have many large rivers and of course the Bering Strait. We are able at various times of the year to move from east to west to east. The navigation season opens in June and July and ends in November, while the greatest concentration takes place between July and October.

3
What kind of ships do you use in the Arctic?

A
We have semi-ice breakers and conventional ice breakers. It is an expensive mode of transportation but the goods are delivered.

4
Are you doing any off-shore drilling for oil and gas?

A
No. Perhaps someone else is, but it would only be at an experimental stage.

5
Do you see opportunities for further technical co-operation between our countries?

A
Yes. There are several areas of exchange possible, especially pertaining to weather.

6
What type of icebreaker does the Soviet Union use?

A
We have tried various types but the traditional method is best.

7
Do you use air transportation to supply your Arctic stations?

A
Yes.

8
Is the Arctic cooling?

A
If this is so we don't know it. Some people say 40 years ago it was warmer and now it is colder, but it is not cold enough for us to be concerned. The year 1970 was cooler than average and it is now somewhat cooler than the average, but this weather cycle is not sufficiently prolonged to affect ice thickness.

18 Meeting at the Leningrad Zonal Research Institute of Experimental Designs (LENZNIIEP)

Present at the meeting were:

Karagin, A. J.
Director

Antonov, A. F.
Chief, Engineering Department

Velly, Y. I.
Chief of Northern Construction Department

Marochnik, L. E.
Chief Engineer and Chief of Construction Department

Liber, E. S.
Chief Engineer, Water Supply and Sewage Disposal Section

Lobanov, I. A.
Chief of the Concrete Laboratory

Verashchagin, O. M.
Deputy Chief Architect

Rimsky-Korsakova, T. V.
Deputy Chief of Northern Construction

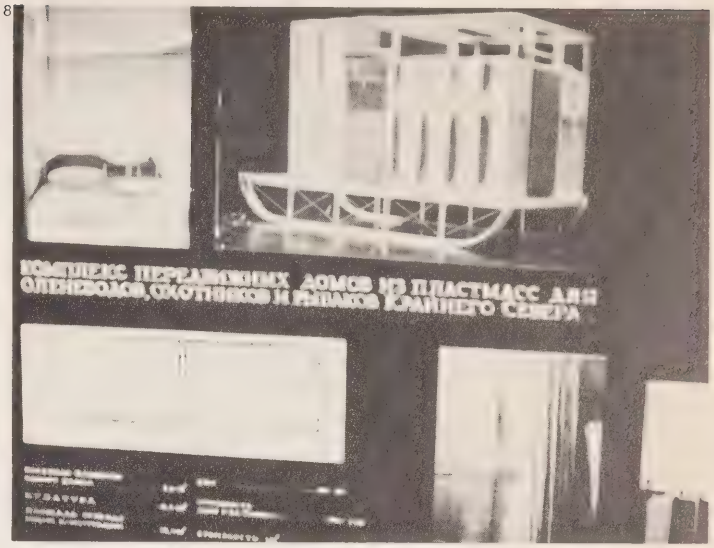
Demidov, P. M.
Engineer in the Institute of Management

Although this institute is responsible for design and construction research throughout the USSR, its chief responsibility is the Soviet North. The institute's responsibilities include: design of buildings, research on building construction, housing studies, services for buildings, supply of documentation and designs to Siberian Institute of Designs, and co-ordinate projects for various institutes in the north. Over 1,000 employees, of whom 500 are specialists in design and standardization of design, are employed in the following departments:

- Architecture;
- Engineering;
- Specialized sections to study such special projects as:
  - Space frames;
  - Complicated steel structures;
  - Apartment buildings with standardized designs;
  - The design of factories which produce prefabricated elements;
  - Urban planning and special problems.

7 Model of a proposed design for Arctic city of three thousand inhabitants.

8 Portable prefabricated trailers are designed to be used by reindeer herders, hunters and fishermen.
Data:
Living space 5.6 m^2;
Volume 40.5 m^3;
Total Area 35.0 m^2;
Weight 480 kg;
Cost at Tyumen 1760 roubles
Cost/meter 319 roubles



- Construction department;
- Laboratory of applied electronics;
- Laboratory of physical testing;
- Laboratory of mechanical testing;
- Laboratory of thin-shell reinforced concrete structures;
- Laboratory of foundation building on permafrost.

Nearly all structures in the north are prefabricated using reinforced concrete with the insulation material aedite incorporated in the concrete panels. The new settlements temporary buildings are, whenever possible, built of light-weight local materials. Where it is impossible to use local materials, the structures are manufactured in southern regions, shipped north, and assembled for use until permanent structures are built.

The institute has designs for future Arctic towns of from 25,000 to 50,000 people. In the Tyumen Oblast near the town of Surgut, apartment buildings are being constructed which are all connected by an enclosed mall leading to a covered town centre where stores, shops, etc., are located.

Small portable prefabricated houses have been constructed for use by reindeer herders. There are 120 such units each housing a team of six to eight herders with three units to a team for kitchen, sleeping accommodation, and storage.

More unit construction is proposed for apartment complexes. It is proposed to build a unit construction factory in Norilsk in the very near future.

Foundations

All buildings of more than two storeys built on permafrost are on piles. Very few new buildings have less than two storeys and certainly none in the cities. Pilings in permafrost go to a depth of between five and seven meters, depending on the applied load on each pile. Construction is carried on the year round, including the drilling and placing of foundation piles. Very few buildings are built on footings. Piles are placed in the following way:

- Drilling of a hole to the required depth;
- Filling the hole with slurry;
- Placing the reinforced concrete prefabricated pile in the hole;
- If a boulder is found in the ground the pile is moved to avoid it.

There is an air space of at least one meter between the ground and the building.

In the earlier stages of construction on permafrost the piles for large buildings sometimes failed. This was due to expansion of the beams on top of the piles inducing sheer and tension forces in the piles. The problem was corrected by incorporating expansion joints in the beams.

Temporary buildings which are not heated may be built on a gravel pad approximately 1½ meters thick. The footings rest directly on the gravel pad with no air space between the building and the top of the gravel pad.

All elements of the structure are generally prefabricated. Concrete is widely used, and there are factories all over the Soviet Union prefabricating structural elements of reinforced concrete. In remote settlements steel and aluminium can be used as construction materials.

Part IV Discussions in Siberia

Yakutsk

19 Meeting at the Council of Ministers of the Yakut Autonomous Soviet Socialist Republic

Present at the meeting were:

Ignatiev, I. G.
First Deputy Chairman

Kornilova, A. T.
Deputy Chairman

Petrov, P. A.
Minister of Health

Sharin, N. I.
Minister of Education

Kononov, V. I.
Minister of Welfare

Klimentov, D. D.
Minister of Culture

Bol'Shakov, I. A.
First Deputy Chairman of Gosplan, Yakut ASSR.

Smirnov, V. P.
Chairman of the Yakutsk Executive Committee (Mayor)

Kuzmin, A. I.
First Deputy Chairman of the Praesidium of the Yakutsk Branch of the Academy of Sciences.

Dubrovskiy, V. M.
Chief of the Lena River Transportation

Mityashin, M. I.
Chief of the Yakutsk Department of the Ministry of Civil Aviation, USSR.

Fedorov, B. F.
Chief of the Yakutsk Construction Department (Yakuttyazhstroy)

Alekseenko, V. I.
Chief of the Yakutsk Gas Department

Belonenko, V. A.
Chief geologist of the Yakutsk Territorial Department

Druzhinin, G. I.
Deputy Chief Engineer to the Yakutsk Energy Department

Vlasov, G. P.
Executive Assistant to First Deputy Chairman

Introduction

This autonomous republic covers an area of 3,000,000 square kilometers. The population is approximately 700,000, of whom 300,000 are Yakut. Yakutia became an autonomous republic in 1922 and is part of the RSFSR.

The climate here is continental and temperatures range from 30 degrees to minus 70 degrees centigrade. The winters are long but there are a number of sunny days. Permafrost, varying in thickness from a few 100 meters to 1,000 meters, is found almost throughout the whole area. Were it not for the permafrost, the region would be considered a desert because of the low rainfall. Due to the summer melt, however, some 5,000 varieties of plant flourish here.

Government

There are 203 deputies elected to the USSR and RSFSR governments, of whom 103 are workers and peasants, while the regional council has 900 individuals, of whom 600 are peasants. Local Soviets (councils) have a total of 9,000 members and representing the Supreme Soviet three out of the 11 members are workers.

The Yakutsk city government is made up of 42 members serving two-year terms with the mayor or chairman of the council selected by the council. The city operates on a budget of 40 million roubles a year and is responsible for housing, water and sewage, schools, etc.

9 Outside the Council of Ministers of the Yakut ASSR. New apartment building is being constructed in the background.
10 Mr Chrétien meeting with Mr. Ignatiev, Deputy Chairman of the Council of Ministers of the Yakut ASSR.
11 Discussion with several of the Ministers of the Yakut ASSR.
12 Downtown Yakutsk.
13 One of the main boulevards in Yakutsk.

9

11

10

12

13

14 Older section of the city which will be reconstructed during the current 5-Year Plan.
15 Two-storey wooden row housing.

14

15

Industrial Development

The diamond industry began in 1955 with the discovery of diamonds in the area now known as Mirny. This industry received the Lenin Banner this year, and production has increased 400 per cent in the last five years with a further increase of 60 per cent proposed in the new five year plan.

Gold exploration and exploitation began in 1924 and the largest gold mines are now found in Yakutia, many of them placer mines. There will be a 30 per cent increase in the production of gold from this region in this next five-year plan.

The tin industry, situated in the northern part of Yakutia, is also very important.

The gas industry, established in 1967, is the newest in this republic, but is considered to be most important for the social and economic development of the region. The estimated reserves for Yakutia are 12.8 trillion cubic meters and many furnaces have been converted to burn gas. A gas pipeline was built on permafrost from Tas Tumus to Yakutsk on the Bestyakh. The prospect for the gas industry in the republic is very encouraging.

Energy

During 1970, 1.4 billion kilowatt-hours of electrical energy were produced in Yakutia. The source of power for this electrical energy was either hydro or thermal.

The Vilyuy hydro-electric power station (Chernyshevski) is one of the most important in the north because it is built on permafrost. The lessons learned from this project will be applied to various projects in the northern areas of the autonomous republic and other northern regions. Plans are under way to build more hydro-electric projects in Yakutia, especially on the Kolyma River.

The thermal power station in Yakutsk is now using natural gas from the Tas Tumus field. There were only three such thermal stations in Yakutia in 1970, but it was apparent from discussions that more were being planned.

Seven hundred thousands roubles will be invested for developing hydro-electric power within the next five years.

Construction

There are many difficulties associated with construction in this region because it is entirely on permafrost.

In the Yakutsk area alone 1,850,000,000 roubles will be invested in construction. Money has been allocated for the development of 42 industrial and housing projects.

16 Road construction and installation of concrete culverts.
17 Installation of precast sewer manholes.
18 Building being constructed from cement blocks and bricks.

River Systems
The most important river system in Yakutia is the Lena Transportation System. It is the largest in the USSR and has greatly helped the development of the north.

The development of a region in the north depends on the river, air, and road network. The Lena and all its tributaries, the Yana, the Indigirka, and the Kolyma rivers are the main north-south transportation networks in Yakutia and the most important means of cheap and reliable transportation.

Agriculture
Agriculture, reindeer herding, hunting, fur processing, and fur breeding are important in Yakutia. There are 47 Kolkhozes and 33 sovkhozes in which there are 365,000 head of cattle, 160,000 horses, and 365,000 reindeer.

Potatoes, wheat, cabbage, and other such crops, together with greenhouse tomatoes and cucumbers are grown in this area. In spite of such a vast agriculture program, it is necessary to bring in supplies from southern regions.

Investment in agriculture will be doubled during the next five-year plan, totalling 128 million roubles.

Education
It was stated that all persons living in the republic are literate and all children are in school. Education has developed extensively and is free.

All schools have the same program, regardless of which language is used. The Russian language is taught in the first year in all native schools.

There are 18 high schools, a University of Yakutsk, along with 21 scientific institutions in Yakutia. One person out of 11 has a higher education, and in Yakutsk, the number of university students per thousand of population, exceeds the figures for West Germany, Italy, and France.

Eight years of schooling are compulsory and are divided into three years primary and five years intermediary. Over 15,000 children are in the program. If the child's parents choose the native tongue as the first language, Russian is taught as a subject from the first grade. If, on the other hand, Russian is chosen as the primary language, all courses are then taught in Russian. Since the Yakut language is the main language in this area, schools are taught either in Russian or in the Yakut language.

16

17

18

19 A new administration building under construction.
20 The hydrofoil is a common form of transportation on the rivers in the USSR. This one was operating on the Lena River.
21 Dredging on the Lena River.

22 Port facilities at Yakutsk (Lena Transportation System).

19

20

21

22

If the child successfully completes eight years of basic education and then a two-year secondary course equivalent to our senior matriculation, he may go on to university on a scholarship provided by the government if his grades warrant it. A university student gets a northern pay increment similar to the one given to workers in the region.

Queried on the education system, the Minister of Education stated that the Yakut language is used until the eighth grade, after which all courses are taught in Russian. The Yakut language, however, continues to be taught as a subject.

By 1975, secondary education will be possible for all students. Pedagogical questions are resolved by the Ministry of Education, RSFSR.

Health, Welfare and Culture

Children go to nurseries and there are schools for orphans. University education is free to students if they qualify and the government provides a scholarship. Allowances are also provided to young married couples, especially when children are born.

Local radio, TV, and press are encouraged and there are three professional theatres in Yakutsk. On a nationality basis, Yakutia occupies fourth place for membership in the writer's union and Yakut art is ancient and well developed.

Sports are traditionally popular, especially wrestling. In a recent USSR championship nine Yakuts were finalists.

In 1960, the majority of the kolhozes were converted to sovkhozes. Pensions are granted at age 55 for men and 50 for women, if they live in the extreme north. Relations between various nationalities are very good and intermarriage frequent.

Questions

1

I am interested in hearing more about your educational system.

A

The main language is Yakut. We start teaching it in nursery school and it is continued for eight years of grammar school. The parents may choose which language they wish their children to learn, and 90 per cent choose their native tongue. Russian is taught as a secondary language from the first grade. Our books are in the language of the nationality. Boarding schools are for the children of people who live on the land and we have 12 such schools with 15,000 children in them. Eight years of education are compulsory for all children. If you wish to stay a further two years you can. The school board has the right to enrol students in junior colleges or vocational schools.

2

How is the school board set up?

A

It is appointed by the Minister of Education, who is appointed by a board of teachers.

3

Who decides the language of the students?

A

The teacher and the parent.

4

What is the function of the school board?

A

The function of the school board is to resolve all problems that teachers and students may have.

5

How many children are there to a classroom?

A

There are approximately 40 to a classroom, but some may have as few as five.

23 The Yakutsk State University.
24 Mr. Chrétien meeting the University faculty members.

20 Meeting at the University of Yakutsk

Present at the meeting were:

Popov,
Director of the University

23

24

The University of Yakutsk was founded in 1956 as a pedagogical university having three faculties and 700 students. There are now seven departments serving 4,000 students, including an extension evening course for another 2,500. The particular requirements of the Yakut Autonomous Soviet Socialist Republic are reflected in each of the following departments: medicine, agriculture, geology, civil engineering, mining engineering, physics and mathematics, physical geography, history, and foreign languages.

The student body is 70 per cent Yakut and 30 per cent other nationalities: 60 per cent are girls. There are 470 professors, six of whom have their doctorate and 170 their master degree.

Deserving students receive scholarships irrespective of family income. In addition, each student receives a 40 per cent northern bonus together with free boarding, housing, and medical care.

Self-governing student bodies participate in scholarship awards, administration of dormitories, and also student discipline, but not in the operation of the university. During the summer students join work brigades in the north.

Minority nationalities such as Evens, Evenks, and Chuckchi are given special assistance upon entering the university, including training in the Russian language if necessary. Russian is the language of instruction at universities. If native students are not proficient in it by the 10th grade, they go on to a university pre-entrance year (known as zero grade) in order to learn Russian and to review their past learning. If they successfully complete this year, the students may enter the university without an entrance examination which is, however, compulsory for all other students. There are educational problems among northern people, particularly with regard to language, and a special ministry has been formed to strengthen the students' position at universities.

People are admitted to the university up to the age of 35 although students usually enter directly from their 10-year school program. Approximately 750 new students are enrolled each year by the university out of an application of 4,000 to 5,000 persons. Half the applicants are eliminated by the entrance examination and it is quite usual to have three to four individuals applying for one vacancy. Of the students who are finally accepted, five to six per cent fail and drop out.

The background of all students is studied to see whether they are orphans, represent a minority group, a worker group, or have recently been released from the army. These individuals get preference to students who have recently completed high school. Where students

apply directly from high school they are placed in a separate category. Individuals in this group must have better credentials than those who are ex-servicemen, herders, hunters, or workers from factories in order to be accepted at the university.

The school system is broken down as follows: 10 years at elementary and secondary, five years at university as an undergraduate, and three years at university as a post-graduate. A master degree is therefore granted after eight years at a university or after a total of 18 years in the educational system.

Of the foreign languages taught, English is the most popular, followed by French and German.

Questions
1
Do natives have problems adjusting to their new life?
A
Since you are northerners, we have no hesitation in telling you that we have our problems in this area.
2
Is the main language in Yakutia, Russian?
A
Yes. We have special departments for local minorities. We also teach and learn other languages such as English, French, and German.
3
With respect to the northern people who attend universities, do you have problems with culture as well as language?
A
Our greatest efforts are directed towards northern people. Before he can enrol at a university a member of a minority group has one year of preparation.
4
What part does the student council play in the work of the school?
A
They play no part in the administration or course work. They concern themselves only with the general life in matters that pertain to students.
5
Does each particular region have its own education system?
A
No. The educational system is a national one based on that of the USSR and each autonomous republic, oblast, and national territory follows the national system.

21 Meeting at the "Yakutskenergo" (Yakutsk Energy Administration)

Present at the meeting were:

Druzhenin,
Deputy Chief

Dunaevski,
Chief Engineer of the Yakutsk Gas Thermal Electric Station

There are three principle types of power station producing electrical energy in Yakutia: hydro-electric, and diesel-electric and gas-electric turbine thermal plants. Total capacity within Yakutia is over 600 megawatts including 35 megawatts by diesel, 400 megawatts by hydro, 60 megawatts by gas turbines, and 100 megawatts by coal- or gas-fired steam plants.

There are 500 kilometers of 220 KV line, 450 kilometers of 110 KV line, 300 kilometers of 35 KV line, and 450 kilometers of 10.4 KV line. The projection for the future is to have from 3,000 to 3,600 kilometers of transmission lines.

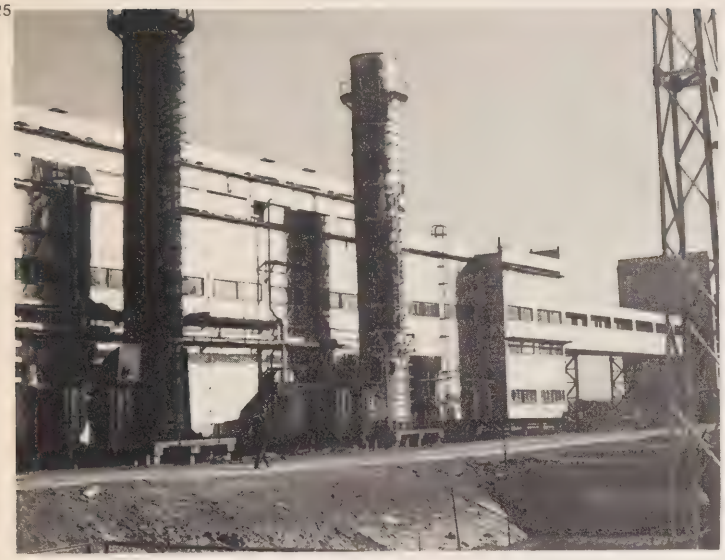
Yakutsk Gas Thermal Plant
The gas-turbine thermal station has two 30-megawatt units in operation and two similar units are under construction. While visiting the plant, only one of the units was operating, presumably because of the light load. Gas consumption is 240,000 cubic meters a day with from 8,200 to 8,400 kilo-calories per cubic meter heating value. Thermal efficiency, including waste heat recovery, is said to be 23.6 per cent. The gas composition is 98 per cent methane with .02 per cent carbon dioxide.

The diameter of the pipeline coming into the power house is 325 mm (12.8 in.) and there is a pressure reducing station adjacent to the power station. The gas turbine units were manufactured in Leningrad.

Tas Tumus (Ust Vilyusk)–Yakutsk–Pokrovsk–Bestyakh Gas Pipeline
The Tas Tumus–Yakutsk section, built over permafrost, is 400 km long and has a pipe diameter of 500 mm (19.7 in.). The section between Yakutsk and Bestyakh is supposed to be 250 mm (9.84 in.); however, it was observed that outside of Yakutsk there were two 325 mm (12.8 in.) diameter pipelines. The pipeline to Yakutsk was completed in 1967 and operates at natural well pressure with no compressor assistance. Well pressures are in excess of pipeline pressures and with the resultant drop in temperature thawing of the permafrost is not a problem. In the construction of this pipeline, 30 per cent has been buried underground, eight per cent lies on the ground, and 62 per cent is elevated on piles. The thickness of the permafrost under most of the pipeline is 200 meters with an active layer of ½ to 3½ meters.

25 Yakutsk gas thermal plant. Exterior covering is aluminum panels.
26 Gas turbines.
27 Inside pressure reducing station adjacent to the gas thermal plant.
28 Gas pipeline divides into two 325 mm lines after the Yakutsk Gate Station. Pipelines are buried in the earth berm outside the station and each line is wrapped in a bitumen covering.
29 Earth berm covering pipelines. The earth was taken from an area immediately adjacent to the pipe.
30 Pipelines on piles on the outskirts of Yakutsk. Erection equipment is also shown.

25



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31 Wooden piles are interspersed with concrete piles.
32 Mr. Chrétien examining two reinforced concrete piles with transom to allow for pipe movement.
33 Pipelines crossing a roadway.

The pipeline divides into two 325 mm (12.8 in.) lines after the gate station at Yakutsk. This section, between the gate station and the town, was described as being experimental, with part of it buried, another covered by an earth berm and a final section elevated on piles.

Two 325 mm (12.8 in.) gas lines were observed in Yakutsk which were elevated on piles about 15 feet above the ground. Two types of pile were used: a single reinforced concrete pile about 12 inches square used alternatively with two wooden telephone pole-type piles spaced approximately 30 to 50 feet apart. About every 300 yards there was a 30-foot-long expansion loop off-set about 40 to 50 feet.[28] Steel saddles were welded to the pipe and bolted to the concrete piles but there did not appear to be any restraints on the intervening wooden piles. The pipeline was said to operate at 35 atmospheres (515 lbs. per sq. in.) but the pressure at the city gate station was 17 kilograms per square centimeter (240 lbs. per sq. in.).

[28]See Photo 37.

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34 Original home of the Permafrost Institute, Academy of Sciences, Yakutsk.
35 New home of the Permafrost Institute.
36 Laboratory dug out in the permafrost underneath the Permafrost Institute.

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22 Meeting at the Permafrost Institute

Present at the meeting were:

Professor P. I. Melnikov
Director

This is the only institute in the Soviet Union that does theoretical and practical research on all aspects of permafrost. Although its headquarters are in Yakutsk, it is a branch of the Academy of Sciences whose main headquarters are in Novosibirsk.

The institute has a staff of 400 who carry out all field and laboratory work and maintain various field stations. One such station is at Chernyshevski and it has been set up to study the hydro-electric power project on the Vilyuy River. This project has been built on permafrost and the research is to determine what is happening to the permafrost on the banks and on the bottom of the huge reservoir. A second station is at Igarka and its members apparently will investigate the operation of oil pipelines in permafrost.

Although the entire republic is in the permafrost zone, it reaches its greatest depth of 1.5 km in the north part of Yakutia. In the vicinity of Yakutsk, the depth of permafrost reaches 200 meters with an active layer of 1½ to 3½ meters.

Water is obtained at 2.5 degrees centigrade at a depth of 550 meters adjacent to the institute. The city obtains very soft water from Jurassic sediments below permafrost.

Pipelines

This institute did a large share of the work in planning the gas pipeline from Tas Tumus to Yakutsk. On the basis of its research, information was provided on which areas would be suitable for underground and above-ground construction. It was indicated by Dr. Melnikov, that the Ministry of the Gas Industry made the final decision, since the scientists could not agree among themselves whether to build the pipeline above ground, on the ground, or in the ground.

The members of the institute have observed the behaviour of this pipeline and are satisfied that gross theoretical errors have not been committed. There have been no pipeline breaks, but large temperature variations have caused sections of the line to slip off the piles. A zig-zag type of construction was used together with expansion loops to deal with the extreme temperature variations. Expansion joints are situated every 100 meters. Although the line has been in operation for four years, an evaluation of its performance has not been completed. Experimentation is also being conducted on the above-ground construction which includes the use of piles and various other types of support such as crossed wooden logs, cribs, and truss suspensions.

37 Typical expansion loops provided to deal with extreme temperature variations.
38 Saddle on reinforced pile.

The reservoir pressures at Tas Tumus are about 180 atmospheres and in reducing this pressure to 50 atmospheres the gas is cooled to between —15 and —20 degrees centigrade. Since the distance from the gas field to Yakutsk is relatively short, there is no need to have compressors. Dr. Melnikov, however, foresaw the problem of compression, i.e. compression will raise the temperature which in turn will necessitate a cooling system. This will lead to increased costs both for the compressors and the cooling equipment necessary to prevent thawing.

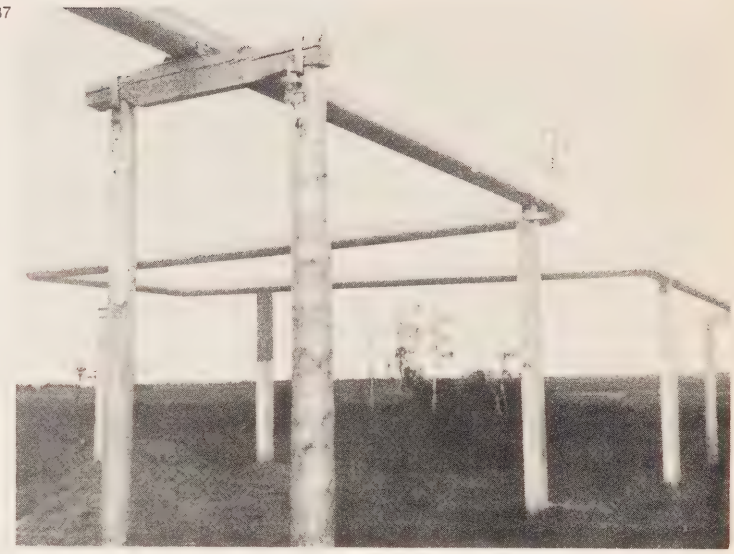
To date, no studies of gas cooling have been made since no compression has been necessary. Oil, because of its natural heat, is considered more difficult to transport but has yet to be studied by the institute. Large diameter pipelines also present greater problems and these too have not been studied in permafrost.

Local geology determines the type of pipeline construction: if fluvial material is available, the level of the land can be raised; if there is solid rock close to the surface, as in Canada, construction is considerably easier; and if there is a high ice content in the soil, as in the area of Yakutsk, above-ground construction is preferred.

There is no problem in laying pipelines if the soil is reliable since they can be laid in the ground or in a berm. This is the cheapest way of building a pipeline, but one negative feature is that it can easily be broken. Although surface pipelines are usually cheaper, those found in trenches are better. In the Soviet view lines are best constructed close to the ground on the surface.

There is no pipeline operating under water and covered with sea ice. The institute is only now beginning to study permafrost conditions off-shore from the Arctic Coast.

37



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39 Entrance to the Main Building of the Academy of Sciences, Siberian Division.

23 Meeting at the Academy of Sciences

Present at the meeting were:

Kuzmin,
Director of the Academy of Sciences

This is the Yakutsk Branch of the Academy of Sciences which was established with the main purpose of developing theoretical and practical studies dealing with the economy, culture, and natural resources of the region. There are several institutes, including geology, astronomy, economics, language, physical and technical problems, and two other departments.

Professor Kuzmin's own speciality deals with cosmic plasma studies. A large installation covering 20 square kilometers, has been constructed to record the effect of cosmic rays in the order of 5×10^{19} electron-volts. Here, studies are also conducted on the earth's magnetic field.

The institute dealing with northern physical and technical problems is also concerned with the problem of thermal insulation, as well as the use of low-temperature materials. The department of geology is engaged in the study of the natural resources and methods of exploiting these resources. The department of biology is involved with the flora and fauna, as well as with the reindeer herding industry. There is also a department of ethnography, chaired by Professor Sofronov and a language institute. The department of economics is primarily concerned with the economic development of the region.

More than half the staff is composed of local graduates from Yakutia. There are 60 post-graduate students and 400 scientists working in, or associated with, the Academy, including 11 full professors and 150 Doctors of Science. The budget of the Academy is eight million roubles.

The main native group in this area are the Yakut, but there are also small groups of Evens, Evenks, Yukagirs and Chukchi. Some of these people still lead a nomadic life and the government with its resettlement program is attempting to establish them in settlements and permanent quarters. Many nomads have been lodged in large apartment buildings during the last 10 to 15 years which in turn has resulted in certain social problems associated with the moving of migratory people into permanent quarters. Some of these people are not yet prepared to abandon their nomadic way of life and live in large apartment buildings.

On the other hand, government officials are also trying to preserve the traditional occupations of herding and hunting. The rejection of the traditional way of life by the younger people has led to a certain amount of conflict between the older and younger generation, and these problems require immediate solutions. For people who cling to the traditional way of life, the state is making an effort to improve living and working conditions both in and out of the settlements. One such attempt has led to the provision of temporary settlements in the tundra and portable trailer-type homes in order to make life easier for the hunter and the herder.

39

Questions

1
How long do herders stay in the field?
A
The herders are out for a period of 20 days and their families usually stay behind in settlements. Trappers and hunters live in settlements and leave their families there, while they are trapping and hunting.
2
Is fur-farming a success?
A
Fur-farming is not an economic success; however, we do get considerable furs this way.
3
Do your trappers work for wages?
A
Trappers are paid a basic minimum wage and receive so much for each pelt. They do not like working for wages.
4
Are trappers encouraged to seek wage employment when they are not out on the land?
A
It is the trapper's decision whether or not he wishes to seek wage employment when he is not trapping.

Discussions with geologists at the Academy of Sciences (Mr. Hunt and Mr. Hetherington)
The Academy of Science studies geology and problems of natural resources in the Yakut ASSR. Their prime responsibility is oil and mining geology. In some cases the chief geologist's department does exploration work and drills wells. They are also responsible for research in areas such as the Tyumen Oblast.

Geologically, the surface in the Tas Tumus gas area is Cretaceous. Principal production is from sands of Jurassic age although the Triassic and Permian are also productive. The depth of the wells is two to four kilometers (6,500 to 13,000 feet) and pressures range from 180 to 400 atmospheres (2,600 to 6,000 pounds per square inch). There are more than 10 gas fields at Tas Tumus. Prospective sediments in the centre of the basin range from five to six kilometers although present drilling has only gone to four kilometers. The typical gas field at Tas Tumus is two kilometers deep and has an area of 20 to 1,500 square kilometers (7 to 570 square miles). The structures appear to be mostly round with a diameter of five to 15 kilometers (three to nine miles). Pay thicknesses range from two to three meters (three to nine feet) up to 30 to 50 meters (100 to 165 feet). Many of the fields have multiple zones in the Jurassic, Triassic, and Permian which are a sequence of sand and shale.

Permafrost is 400 to 1,000 meters deep and the drilling procedure involves setting 13 to 18 meters of conductor pipe in permafrost. If necessary, subsequent strings of casing are cemented in permafrost with special cement which sets quickly at low temperatures. Intermediate casing strings are run with a few hundred sacks of cement rather than cementing the surface.

Gas production is sometimes bothered by hydrate problems and in such cases heating strings are used. Using 10 rigs, 35,000 meters a year of hole are drilled.

There is no gas production in permafrost zones. There is, however, gas in the solid hydrate form in certain areas and an attempt is being made to develop methods to produce such gas.

Known reserves in Yakutia are 600 billion cubic meters and they consider the prospects to be 12 to 13 trillion cubic meters.

Oil has been discovered in Precambrian rocks southeast of Yakutsk and an additional oil discovery has been made on the Arctic Coast of Yakutia, but has not been developed because of its remoteness.

24 Visit to the "Yakutyashstroy" (The Yakut heavy industry construction project)
There were many apartments being built in Yakutsk with construction continuing throughout the winter months. A visit was made to a new five storey multi-family housing development in Yakutsk.[29] Equipment appeared to be of good quality and in operation on the site. The two most important pieces of equipment were the pile drilling rig and the cranes to erect prefabricated elements.

All structural elements were prefabricated. The prefabricating plant is roughly 500 kilometers from Yakutsk. Wall panels come complete with doors and windows.

Visit to the Institute of Design of Yakutsk (Mr. St. Amant)
This institute is responsible for all phases of construction, planning, and design in Yakutia and employs 400 engineers, designers and architects. They have responsibility for all projects costing less than three million roubles, while costlier projects are the responsibility of other ministries, usually those of the USSR.

The plans of an office building for the Council of Ministers provided the following information:

Dimensions
64 m x 12 m x 6 storeys equals 4,608 sq. m.
25.5 m x 15 m x 3 storeys equals 1,127 sq. m.
Total area 5,735 sq. m.

Conversion
5,735 x 10.76 equals 61,730 sq. ft.
Estimated cost is 2,500,000 roubles. A conversion rate of 10 percent results in a cost of 2,750,000 dollars or 44.55 dollars/sq. ft. The permafrost active layer in Yakutsk is around 2½ meters deep.

The City of Yakutsk will be rebuilt by 1975, and all its inhabitants will live in apartment buildings. The plans for the new city call for 100,000 people.

[29]See Appendix 8.

40 Concrete piles placed in drilled holes.
41 Precast reinforced panels being erected. A drilling rig is seen in the foreground.

42 Piles have been cut down to the required height, refinished and construction of the building is ready to begin.
43 A typical construction site: L. to R.: Mr. Sidovski, Mr. Fournier, Mr. Chrétien, Mr. Hancock (behind Mr. Chrétien), Mr. Buchanan, Mr. Fedorov, Mr. Ermolenko, Mr. Vlasov, Mr. Ignatiev, and Mr. Smirnov.

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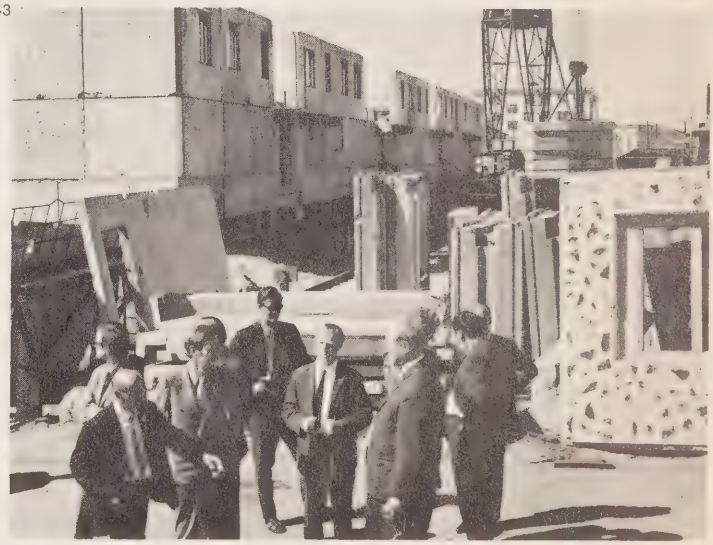

44-45 The inhabitants: Yakutsk and its people during a lunch break.

46 Typical erection equipment used on construction sites. The crane moves along railway tracks which are installed alongside each proposed building site.

47 Panels with pieces of ceramic tile embedded in order to give uniform colour.

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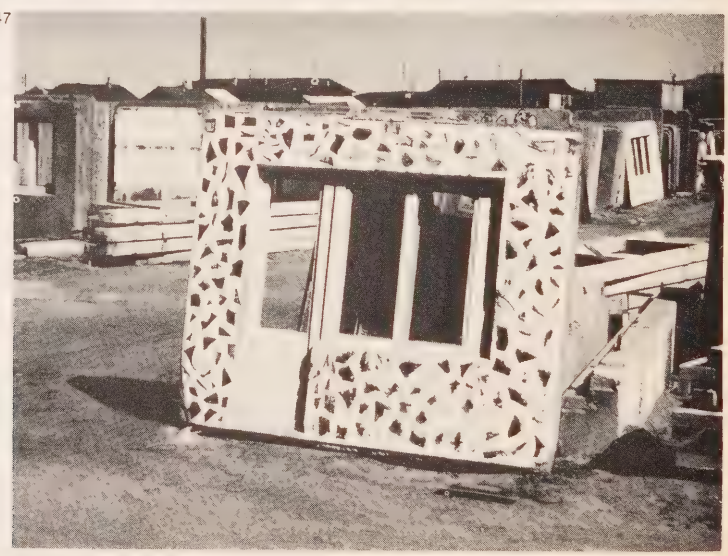

48 Outside Regional H.Q. at Cherski: L. to R.: Mr. Tovrot, Regional Chairman of the Executive Committee of the Nizhnekolymsk Region and Mr. Ignatiev, Deputy Chairman of the Yakut ASSR.
49 Regional H.Q.

Cherski–Zeleny Mys–Nizhnekolymsk

25 Regional H.Q. at Cherski

Present at the meeting were:

Tovrot, N. I.
Regional Chairman of the Executive Committe of the Nizhnekolymsk Region

Anosov,
Local representative

Yablonski, V. I.
Director of a Kolkhoz

Galachkin, V. V.
Construction Engineer (Agriculture)

Egorov, A. A.
Chief of the Construction Industry in Nizhnekolymsk

Ignatiev,
Chief of Culture

Serkin, P. A.
Chairman of local council (mayor) of Cherski and Zeleny Mys

Introduction

Nizhnekolymsk region occupies an area of 80,000 square kilometers with a population of 12,000 people. There are approximately 17 nationalities in this area made up primarily of Chukchi, Yukagir, Evens, Yakuts, Evenks, Russians, Ukrainians, etc.

The area was discovered by the Russians about 320 years ago, but the settlement of Cherski was started only in 1940. The combined population of Cherski and the port of Zeleny Mys totals 9,000 people. The major offices and administrative buildings have water and are heated by a central hot water system, which services approximately 90 per cent of the buildings and 70 per cent of the houses. Water is provided from the Kolyma River and new apartments have hot water. A central sewage system services 20 per cent of the apartments and most of them will be connected during the next five years.

Temperatures in this area range from —55 in winter to +32 degrees centigrade in the summer, with an average summer temperature of 12 degrees. The day before our arrival, the temperature reached an all-time record of 32 degrees centigrade (90°F).

Ice breaks up in June and water freezes over by October 1. The Northern Sea Route was ice covered at the time of our visit.

The town of Cherski is the administrative-transportation centre for the Kolyma Region, a major gold area. In addition, close support is provided to northern Chukotka, a major tin- and gold-producing region. The Kolyma River is an important water transportation route and there are three different construction agencies in Cherski and Zeleny Mys.

48

49

50 Main Street in Cherski.
51 New apartment buildings.
52 Cherski and airport as seen from the river.

Reindeer herding, fur-trapping, farming, and fishing
Reindeer herding is a large industry and there are approximately 48,000 reindeer in this area. Six hundred individuals, of whom 33 per cent are reindeer herders, are employed in some aspect of the reindeer industry. Ranges are roughly 420 square kilometers for each herd, giving a distribution of from 50 to 60 head a square kilometer. Each year 13,000 reindeer are slaughtered and 60 per cent of the meat used for local consumption.

Fishing is the second most important industry because of the large stocks of fish found in some 70 per cent of the 70,000 lakes in the region. All fishing takes place in these inland lakes and rivers with a yearly catch of 25,000 centners (approximately 1,200 tons) of various species of fish. Fish is the main export and is shipped out by air all year round. Fishing, whaling or sealing is not carried out in the Arctic Sea by members of this community.

The industry of fur trapping and fur farming rates third in importance, with such fur-bearing animals as white and blue fox, muskrat, and ermine. A blue fox fur farm, run by eight hunters and one specialist, produces between 1,800 and 2,000 pelts a year. The main food of the fox is reindeer meat, which is provided from local herds. Of the fox fur harvested, 60 per cent is wild and 40 per cent is raised in captivity. Furs are delivered to a central point in Irkutsk where they are tanned.

Wages
There is a guaranteed minimum wage and a system of bonuses if hunters and trappers fill their quota. The average income for reindeer herders and various other people associated with hunting and trapping as well as construction is 380 roubles a month including all other benefits. The minimum guaranteed wage is 120 roubles a month for hunters, trappers and herders.

Questions
1
How do your trappers, hunters, and herders move around?
A
Hunters use dogs and sleds, and they have camps along the route. Most sleds are pulled by the reindeer for reindeer herders.
2
What type of educational system do you have here?
A
Three schools have specific curricula for national minorities, i.e. for the Chukchi, Evens, Yukagir, and teaching is in the native language or Russian. Russian is also provided as a subject from kindergarten where the other subjects are taught in the native language.

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53 Approaching Zeleny Mys by River.
54 Port of Zeleny Mys. Ships are unloading supplies which have been transported from Vladivostok.
55 Fuel storage depot.

56 Port facilities.

53

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26 Port of Zeleny Mys

There is a road eight kilometers long between Cherski and the port; however, the trip was made by boat. There were four ships off-loading which had come through the eastern section of the Northern Sea Route from Vladivostok.

The Port had a large dock area approximately half a mile long with five big gantry cranes operating. It was obvious that this large and modern port facility not only serviced the Kolymsk area, but also certain regions of Chukotka.

There were modern five-storey apartment buildings not too far from the docks. Although the group did not have an opportunity to visit the townsite, the mayor of Cherski stated that it was also under his jurisdiction and had all modern conveniences, i.e. central heating, water and sewers, etc.

57 Floating power station "Northern Lights".

58 The control centre inside the power station.

57

58

27 The "Northern Lights" Floating Power Station

Adjacent to the harbour is the "Northern Lights" floating gas-turbine power station. It is the first of its kind in the Soviet Union and was designed to be used in areas of the extreme north having large power requirements in the early development stage, before permanent hydro-electric or atomic-power stations had been installed.

The station arrived at the site in 1967 and apparently will remain as long as it is needed. A hydro-electric plant is being constructed on the Kolyma River and as soon as it is operating the floating station will probably be moved to another location. It has two 10,000 kilowatt units which require major overhaul every 20,000 hours. There is no waste-heat boiler. Transformers are placed on shore rather than on the ship: in new designs, however, this shortcoming will apparently be rectified. The unit is self-propelled and has a 2,000-ton displacement. Ice problems are overcome by special heating systems which prevent the ship from freezing-in during the winter. Several new models of this type of station are under construction for other northern settlements.

It burns 30,000 tons of crude oil a year having a specific gravity of 0.85 at 15 degrees centigrade. The cost of electricity is five to eight kopecks a kilowatt hour.

A total of 60 persons–30 in operations and 30 in administration–run the station.

28 Nizhnekolymsk reindeer breeding sovkhoz

A visit was made to a reindeer herd on the Arctic tundra, 180 kilometers northwest of Cherski and about 30 kilometers south of the Arctic Ocean coast. A working staff of six looks after a herd of 2,900 reindeer. This particular reindeer station consisted of two large tents, one of which was occupied by a Chukchi family. The herder's wife was Tovrot's sister (Tovrot is the Regional Chairman of Nizhnekolymsk).

The station had a radio which was powered by a hand generator. There were about 20 sleds with various sorts of box on them, and dogs and reindeer were used to pull the sleds.

The reindeer are identical in appearance to those of the Mackenzie Delta and the landscape was very similar to that found around Tuktoyaktuk. (Hill).

59 Biplane which is used extensively in supplying the various camp-sites.
60 The reindeer herding station.
61 Chief reindeer herder of this area with a family of one of the local herders in the background.

62 Local herder.
64 Reindeer herd.

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65 Housing in Mirny. Two-storey wooden row housing on the right will be replaced by the 5-storey concrete housing on the left. Water and sewage pipes run underneath the boulevard in a concrete utilidor (See Appendix 8).

66 New housing.

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Mirny

29 Meeting at the Regional Headquarters

Present at the meeting were:

Efremov, G. A.
Chairman of the local and regional council (Mayor)

Soldatov,
General director of the "Yakutalmaz" (Yakut Diamond Industry)

Desyatkin,.T. G.
Deputy Chairman of "Yakutalmaz"

Chegudyarov,
Deputy Mayor

Veliky,
Chief Civil Engineer

Yermolaev,
Chief Architect

Timofaev,
Chief of Finances

The District of Mirny was formed in 1956 and has evolved with the diamond industry. Beside the town of Mirny there are nine settlements within the area having a total population of 47,000. The projected population for Mirny is between 25,000 and 27,000.

In order to create better living conditions, houses, hospitals, cultural centres, etc. are being constructed, and an all-out effort is being made to provide for most amenities. The overall cost of these services averages 25.6 roubles a person while overall expenditures exceeds 32.0 roubles a person. The entire annual budget varies between 63 and 65 million roubles.

There are approximately 15 nationalities working in this region with an average age of 28. The native population is only five per cent of the total and their main occupation is hunting and trapping.

Officials have difficulty providing adequate housing, and only five square meters are provided per person; whereas, in Yakutsk each person has seven square meters. With such a high ratio of young people, there are many children, of whom 13,000 are now attending school. Needless to say, the construction of schools cannot satisfy the demand, since for every three persons, one is studying. Children, therefore, have to attend schools on a two-shift system. Last year 96 per cent of the students passed their examinations and this year 800 children will be graduating from the eighth grade.

Local food industries are being developed and there is a good supply of milk and meat. In addition, a brewery and a vodka factory have been built in Mirny. Clubs, libraries, movies and an automobile club for driving instruction are situated there. A new cultural centre is being built and cultural brigades provide hunters, trappers, and reindeer herders with entertainment in the field. Various types of medical service are provided with 400 doctors and nurses working in the area.

67 New housing under construction.

68 The Yakutalmaz H.Q.

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Rent for a three-room apartment, including all services, such as water, electricity, etc., amounts to 15 per cent of a person's income. The cost is about 18 roubles or 80 kopecks a square meter. The average wage of a worker, including such benefits as northern increments and regional bonuses, is 4,000 roubles a year.

The standard work week is 41 hours. Although in principle, there is no overtime, it is permitted in cases of emergency. If a person has signed a contract he is allowed a vacation of 42 days a year. A contract is usually for three years and includes transportation costs if it is completed. Apparently 70 per cent of the workers renew their contracts after spending the first three years there. Retirement age is 60 for men and 55 for women. If they work in northern mines this period is reduced to age 55 for men and 50 for women. The diamond industry returns approximately five million roubles for such social services as building summer houses, vacations for workers, summer camps for children, as well as other social activities.

Out of a work force of 23,000 in the entire area, the maximum number of persons in the diamond industry is around 2,000. Ninety nine per cent of the workers are in various trade unions and apparently take an active role in them. Unions are responsible for resolving the questions of piece work, housing, and various labour rights and law. Yearly plans are initiated by the factory and special meetings with workers are held to discuss these plans which are then submitted to Gosplan and the responsible Ministry. These latter organizations, however, have the final say as to what the total output will be.

30 The Yakutalmaz (Diamond Combine)

Present at the meeting were:

Danziger
Deputy Chief of all capital construction

Baktunov

Skrinnik
Chief of Mechanical Engineering

Vasilev
Special Assistant

Yakovlev
Deputy Chief of the Diamond open pit mine

This organization is responsible not only for the operation of the mine but also for most of the construction in this area and all aspects of town planning.

There is a mining research institute at Mirny with a staff of 100 who are involved mainly in exploration and the design of diamond extraction facilities. This research group also does limited work on construction on permafrost.

Not too many problems were encountered in the construction of wooden homes. When work began on four- and five-story buildings, however, it was found that the ground was not very stable. The temperature four or five meters below the surface was found to be —5 degrees centigrade and it was therefore necessary to construct a self-freezing pile. A tube was inserted in the pile and kerosene placed in the tube. This kerosene circulated in the pile and lowered the temperature of the pile and the surrounding area 1½ to 2 degrees centigrade which was sufficient to permit the construction of nine-storey buildings.

31 Diamond open pit mine "Mir"
Although the actual extraction of diamonds only began on June 15, 1957, today, every branch of the industry is highly developed. Kimberlite ore is mined using the open pit method with six-cubic meter capacity shovels loading 20-to 30-ton dump trucks. The technique of extracting diamonds in permafrost and under severe climatic conditions belongs to the Soviet scientists who have developed special processes. Their main task was to ensure that labour would be highly productive which was achieved by mechanizing all work. Three hundred and twenty men work in the pit including the operators of all drilling and excavating equipment, drivers, miners and mechanics.

32 Extraction Plant (Factory No. 3)
It is situated on the outskirts of the city five kilometers away from the pit. The plant was built there because bedrock was close to the surface. It was necessary to build on bedrock since large amounts of water would be used in the crushing process and the engineers feared that some of this water would soak into the permafrost and melt it.

Primary crushing reduces the rock to 300 mm size, and secondary crushing to less than 30 mm. A further reduction takes place as the crushed rock passes on to sieves, gravitation, heavy suspension, and flotation where the final material size is less than 2 mm.

The factory uses 100 million kilowatts of electricity annually for which it is charged five kopecks a kilowatt-hour. The factory operates seven days a week with a total of 500 employees working seven-hour shifts.

Chernyshevski

33 Meeting at the Vilyuigesstroy (Vilyui Hydro-Electric Project Headquarters)

Present at the meeting were:

Biyanov, G. F.
Chief Engineer of Construction of the Vilyuigesstroy (Vilyui Hydro-electric Project)

Medvedev, B. A.
Director of the Vilyui Hydro-electric station

Lanchenko, V. P.
Chairman of the Settlement Soviet of the town of Chernyshevski (Mayor)

Andreev, A. P.
Assistant Chief of the Vilyuigesstroy (Vilyui Hydro-electric Project)

Nedosekin, A. S.
Chief of the Technical Division Vilyuigesstroy

Makarov, V. I.
Researcher of the Vilyui Permafrost Scientific and Research Station of the Permafrost Institute, Academy of Sciences

This project is known by several names which, at times, tends to cause confusion. It is familiar as the Chernyshevski Project, which takes its name from the town of Chernyshevski, or the Vilyui hydro-electric project and the Vilyuisk hydro-electric project: both of these names are derived from the Vilyui River. The town of Chernyshevski was built primarily for the construction of the Vilyui project and at present approximately 8,000 persons are living there. Initially, it had been proposed that upon completion of the project only a skelton staff working in the power station would remain. Plans have changed, however, and the town will have a permanent population of between eight and nine thousand inhabitants and become a service and maintenance centre. Organizations operating from there will have the responsibility of constructing power lines, and building and maintaining a transportation centre to service the diamond mines farther north, i.e. at Aykhal and Udachnaya.

69 Use of thermal piles.
70 Close-up of a thermal pile.
71 Open pit mine "Mir".

72 Main Administrative building at Factory No. 3.
73 Factory No. 3.

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74 Road from Mirny to Chernyshevski built on permafrost.
75-76 Town site.
77 Staff house in which the Canadian delegation stayed.
78 View of the operating hydro-electric power station and part of the dam.
79 Group photo: L. to R.: V. P. Lanchenko (Mayor), unknown, B. A. Medvedev (Director of Station), C. R. Hetherington, Sergeev (interpreter), W. Slipchenko, A. D. Hunt, P. Hancock, G. F. Biyanov (Chief engineer of project), Ignatiev, Ermolenko, J. Chrétien (Minister), J. H. Lowe, J. J. Buchanan, Sidovski and G. A. Efremov (Chairman of the entire Mirny Region).

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80 View of dam and power station.
81 View of dam and site of new power station.
82 New power station under construction.

83 Diagram showing cross-sectional view of dam.
84 Diagram showing intake and turbine.
85 Use of wooden and steel pylons for transmission lines.

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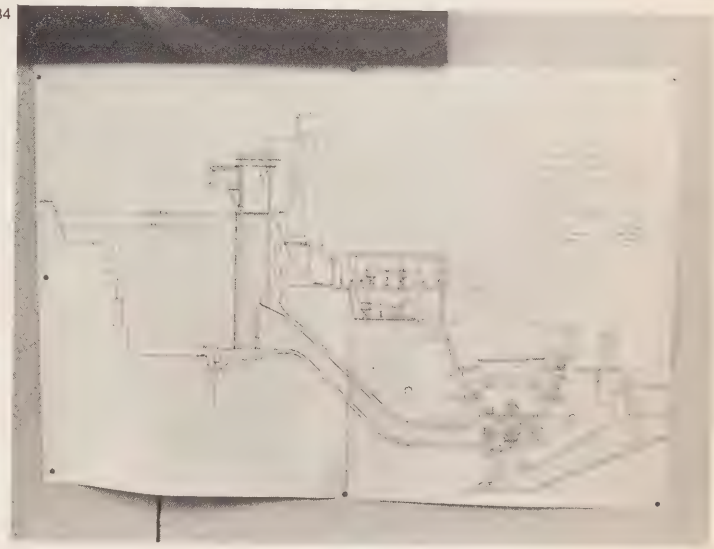

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The Vilyuigesstroy (Vilyui Hydro-electric Project Construction Agency) was created primarily to build the dam and power stations on the Vilyui River, but its activities have been expanded to the construction of the settlement, projects in nearby Mirny, pipelines, electrical distribution systems and also the design of a hydro-electric project in the Kolyma Region. Although this organization started the Kolyma hydro-electric station one and a half years ago, the agency on the Kolyma has now separated from its parent organization. Vilyuigesstroy is also responsible for the Lensk project and for the thermal plant that was built at Yakutsk. With the exception of the main highways in the region, it carries out all other construction.

The cost of the dam and the power station will total 360 million roubles and it is designed to produce 648 thousand kilowatts of electrical power. The first stage of construction has been completed, which included the construction of the dam, and also one power station. The second stage of construction which is under way calls for an additional power station.

The project is of particular interest because it has been constructed in a permafrost area on the Vilyui River. Final capacity will be 560 megawatts, of which 308 is now installed in four Kaplan units of 77 megawatts each turning at 183.3 rpm. The winter peak load was 125 megawatts last year and the summer load was 50 megawatts. Governor pressure is at 40 atmospheres. Spillway capacity is designed for the one-in-one-hundred-year flood and has a capacity of 6,000 cu.m. per second. The water flow of the river is 13,000 cu.m. per second in the summer and 2.5 cu.m. per second during winter. In this respect the river resembles the Pelly or South Nahanni (Lowe).

[30]See Appendix 9 for a complete account of the dam's specifications.

The dam itself is earth-filled using local materials and one of the most interesting aspects of this construction is that the core was placed during the winter months to take advantage of low river flows. The core of the dam is comprised of three screen zones. The first zone has 0 to 150 mm gravel, the second section has 0 to 40 mm gravel and the third or centre core is made up of clay mixed with sand and gravel to stop water flow.[30] The volcanic rock in this area weathers to a depth of one to 2½ meters and the clay is ideally suited for construction. This thin layer of clay necessitated, however, that it be collected from a large area, as far away as five kilometers. The clay was delivered to the dam site in insulated trucks and stored in large piles to prevent freezing, with the addition of calcium chloride to lower the freezing point of the core material. Electric probes were placed vertically in the core material to heat it and allow placement and compaction on the dam. The clay could be handled and compacted down to a temperature of minus 40 degrees centigrade, but no colder. During construction temperatures went down as low as –60°C (–92°F) and rose to 35°C (95°F) in the summer.

The dam foundation is on solid rock while the wings are on permafrost which extends to a depth of 350 meters. After the upstream lake was created there was danger that the permafrost might melt since the heat of this newly formed reservoir would probably melt the ice in the cracks of the rock foundation. (Although the foundation is on bedrock, there are cracks between the layers of rock which are frozen.) If this happened, it was decided that grouting cement would be pumped in to seal off cracks in the foundation. A grouting gallery of concrete was therefore constructed on the river bottom and abutments to allow for drainage of water from melting ice. As ice melted in the cracks, the gallery was used also for progressive grouting of these voids.

This tunnel was inspected beneath the dam. Holes about three to four inches in diameter were being drilled at angles of about 40 degrees into the dam to relieve the water pressure in the core of the dam. The holes near the bank were allowing the water to drain off, while holes farther from the banks were apparently still frozen and no water flow was observed.

Cement content in the structural concrete was 280 kilograms per cubic meter.

Considerable commercial fishing is carried out in the reservoir with a 100-ton boat, together with hundreds of smaller ones, operating there. Apparently a fish hatchery has been constructed below the dam, where spawning fish are netted and their eggs are removed and placed in hatching tanks. As they are hatched the small fish are returned to the river.

86 Summer camp for children which is located 10 miles from Chernyshevski on the road to Mirny.
87 View of reservoir.

Questions

1
Where did the initial power come to build the dam?
A
Initially from a coal- and a diesel-powered generating station 350 miles from here on the Lena River. In addition, railroad diesel-power units provided electricity from a point several hundred kilometers farther south.
2
Why weren't all the trees cleared in the reservoir?
A
Trees were not cleared because it was not economic. The clearing that did take place was 20 kilometers upstream, although the reservoir will extend some 80 kilometers upstream.
3
How much does it cost to produce power?
A
The cost is ½ kopeck per kilowatt-hour.
4
What does the consumer pay for the power?
A
The consumer pays 1/10 of a kopeck per kilowatt-hour and the other 4/10 are subsidized by government. This works out approximately to 15 roubles a month for the average apartment. Industry, however, is charged 5 kopecks per kWh.
5
What are the rents paid in Chernyshevski?
A
They average from eight to nine roubles a month for a three-room apartment with 80 square meters of space, which is actually 50 square meters of living space.
6
Besides the technique of preventing the soil from freezing during the winter months in the construction of the dam, did you introduce other new techniques in dam construction under permafrost conditions?
A
The special grouting gallery through the dam, allowing the drainage of melted water and the grouting of the fissures as ice melted was a new technique. Other techniques included the pouring of concrete under very cold conditions; the use of potassium chloride sulphate in various mixtures; the transportation of soil in insulated trucks, and of course the clay storage mounds heated by electric currents to prevent freezing.
7
What is the rainfall in this area?
A
Approximately 100 mm a year.

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88 Outskirts of Bratsk.
89 New hotel.
90 Main street.

Bratsk

34 Introduction

The group visited the Forest Industry Complex and the Bratsk Hydro-Electric Power Station. The following individuals were met:

Naymushin, I. T.
Director of the Bratsk Hydro-Electric Construction (Bratsk Gesstroi)

Yevtsigneev, S. K.
Deputy Director of Bratsk Gesstroi

Alontsev, M. I.
Director of Bratsk Forest Complex

Perevalov, N. G.
Mayor of Bratsk

Knyazev, K. A.
Director of the Bratsk Power Station

The entire Bratsk hydro-electric project was constructed by Bratsk Gesstroi (Bratsk Hydro-Electric Construction Agency). This organization not only built the hydro-electric dam and power station but also the entire city of Bratsk and the various industrial complexes. Approximately one million roubles are spent daily for construction here.

This agency is now involved in the construction of the Ust'Ilim hydro-electric project further downstream on the Angara River. As in most regions of the USSR, reinforced concrete is the prime building material. It was mentioned, however, that by 1975 steel and aluminum would also be used more and more in the building of various structures. At present, aluminum is being used primarily for the aircraft industry.

When the hydro-electric project was begun in 1956 there were only 8,000 persons living in the area. It has increased to 300,000, of whom 200,000 live in the city itself. The city is divided into five satellite towns.

Seasonal temperatures vary from 30°C to –55°C with rivers freezing around November 15 and breakup occurring around May 25. Although Bratsk itself is not in a permafrost zone, water and sewer pipes have to be placed approximately five meters under ground, because frost penetrates to a depth of three meters.

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91 Sunday afternoon in Bratsk.
92 Airport terminal.
93 Highway between the city of Bratsk and the original settlement for the construction of the city and the hydro-electric project.

94 Wooden restaurant in the older section.
95 Wooden housing in the older section.
96 Two-storey wooden row housing.

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97 New cultural building.
98 Guest house where several members of the delegation stayed.

99 Illustration of the Forest Industry Complex.
100 View of the completed section of the complex. Photograph taken from the breakwater dam.
101 Pulp and paper factory.

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102 Paper processing factory.

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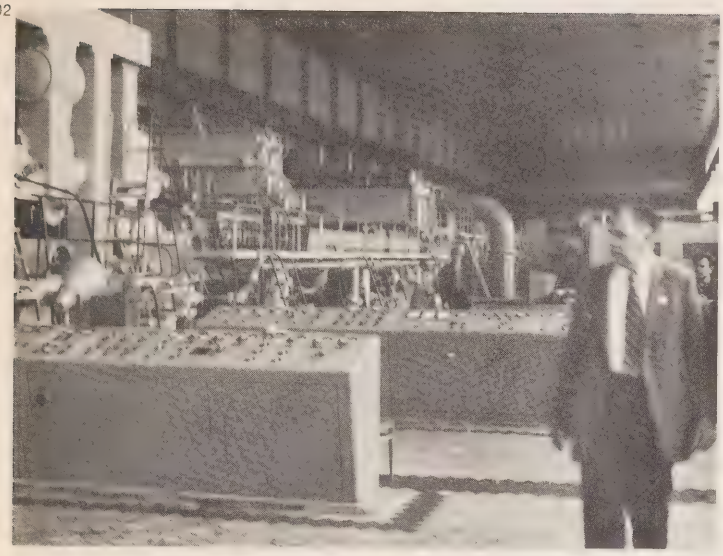

35 Forest Industry Complex

The forest supporting this complex covers an area of 50 thousand square kilometers. The complex is a large integrated industry broken down into three main areas: mechanical, chemical and miscellaneous section. Construction of factories in each section is not yet complete, but when they are fully operational annual production figures will be as follows:

Mechanical Section

- Wood-working factory–700,000 cubic meters;
- Agricultural and railroad factory–190,000 cubic meters (parts for machines are also made here);
- Plywood factory–200,000 cubic meters;
- Chipboard factory–40 million square meters.

Chemical Section

- Cellulose–200,000 tons;
- Cardboard–250,000 tons;
- Viscose cellulose for paper–200,000 tons.
  (A scientific institute is also being constructed for the exclusive use of the chemical section.)

Miscellaneous Section

- Resin factory–10,000 tons;
- Turpentine factory;
- Yeast factory–producing approximately 90,000 tons.

Fifty per cent of the wood will be transported through the Bratsk reservoir system, while truck and railroad will account for the other 50 per cent. The reservoir is open to navigation for 130 days. The plant's stockpile will hold one million cubic meters of wood. Log supply is handled by another ministry which cuts the wood and sells it to the plant. There is also a Ministry of Reforestration which is responsible for replanting.

It is estimated that when the facilities are completed one million tons of cellulose will be manufactured annually. Chloride and caustic soda for the paper making process are obtained from a layer of salt at a depth of 900 meters in the vicinity of the complex.

When completed, total capital investment for the complex will be 1.1 billion roubles. The plant is now half finished at an investment of 500 million roubles. In proportion to production, investment in the factory is high since it includes all facilities. Construction will be complete under the present five-year plan, with the resin factory in operation by 1972, the pressed sawdust and the chip factory by 1973, and the plywood factory by 1974. There are 8,100 persons working at the plant and a total of 15,000 will eventually be employed, of whom 45 per cent will be female. The complex is situated approximately three kilometers from the city of Bratsk.

Effluent from the factories is handled by several methods and all smoke stacks have air cleaning apparatus.

Fifteen million roubles have been spent on a purification field for sewage, and effluent from the plant is pumped into a parallel river system which flows for 90 kilometers before re-entering the Angara River.

Winters are very severe in this region, with temperatures ranging from –45°C to –50°C. Since it is difficult to work below minus 30 degrees centigrade, all outdoor operations in the complex have been housed and can continue throughout the year.

36 Hydro-Electric Power Station[31]

Introduction

The Bratsk hydro-electric power station has 18 turbines with a capacity of 4.1 million kilowatts, producing from 21 to 25 billion kWh annually. The electric power ensures exploration for both renewable and non-renewable resources not only in the neighbouring areas, but also in an area exceeding one million square kilometers.

The Bratsk hydro-electric station is connected by 500 kV transmission lines with the Irkutsk-Cheremkhovo industrial region and the Krasnoyarsk area. This station has become one of the most important links of the Central Siberian Power System, integrating the hydro-electric stations on the Angara, the Yenisey and the Ob Rivers; and the thermal-electric power stations of Irkutsk, Angarsk, Cheremkhovo, Krasnoyarsk, Kemerovo, Novosibirsk, Omsk and of other Siberian towns.

[31]Information on the Bratsk Hydro-Electric Project is taken directly from a handbook, *Bratsk Hydro-electric Station.*

103 Bratsk hydro-electric power station.

104 View downstream from the dam.

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Hydro-electric stations of the Angara River Cascade	Ultimate capacity, thous. kW	Maximum head, m	Annual average electric power output billions kWh
Irkutsk	660	31	4.1
Sukhovo	400	13	1.8
Telma	400	12	1.7
Bratsk	4,500	106	22.9
Ust'Ilim	4.320	90	21.9
Boguchany	4,000	76	19.8

Angara River

The hydro-electric potential of the Angara River is estimated at about four billion kWh annually.

Length of the river,	1,850 km
Catchment area,	1,056,000 sq. km
Total fall,	380 m
Annual run-off at the site of the Bratsk dam,	91.7 cu. km
Normal annual flow at Lake Baikal,	1,926 cu.m/sec
Maximum water flow at the river mouth,	13,400 cu.m/sec

A cascade of six hydro-electric stations will be built on the Angara River with total installed capacity of about 15 million kW and annual average electric power output exceeding 70 billion kWh.

Dam Characteristics

The Bratsk hydro-electric station is comprised of the following structures: the river-channel concrete dam, height –125 m, length–924 m; power house with water intakes and penstocks; concrete and earthfill dams on both banks; and 220 and 500 kV transformer stations. The Taishet-Lena railway crosses on top of the dam and there is a highway at a lower level. The navigation structures will be built in a second stage of construction, after completion of the Ust-Ilim and Boguchany hydro-electric stations. Their completion will result in a flooding of all rapids on the Angara River and provide a through waterway from Lake Baikal to the Yenisey River.

Total length of water-retaining structures,	5,190 m
Maximum head,	106 m
Maximum discharge capacity of the structures,	12,240 cu. m/sec.

105 Diagram showing plan view of the dam.
106 Diagram showing cross section of spillway.

107 Generator inside power station.

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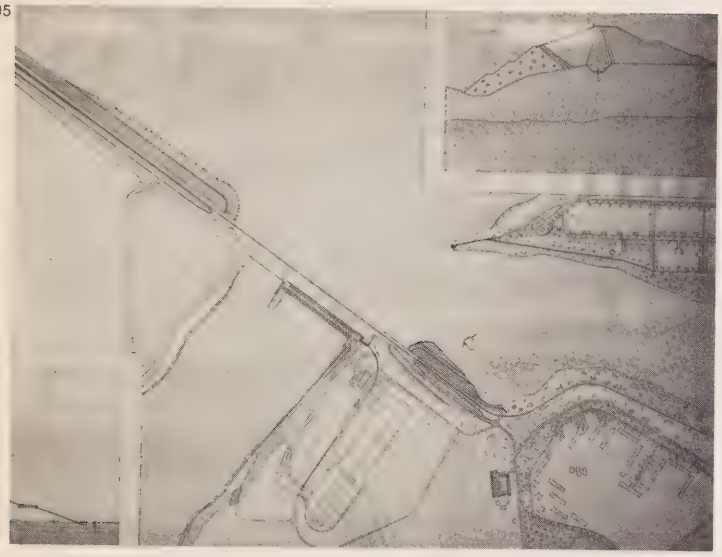

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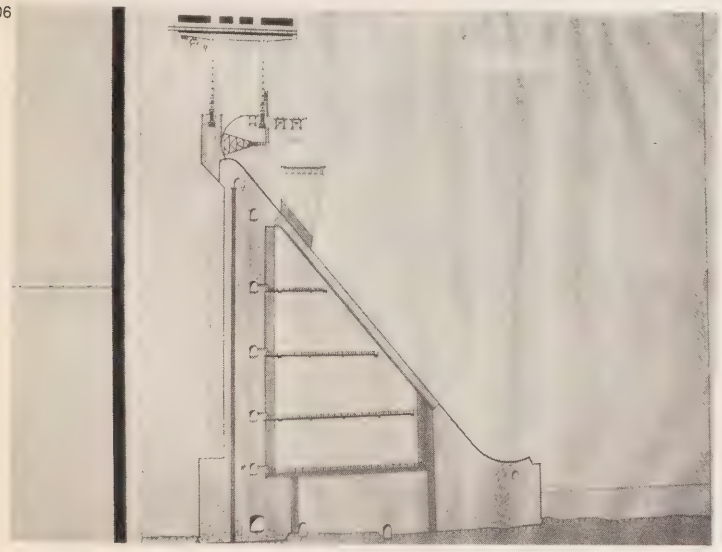

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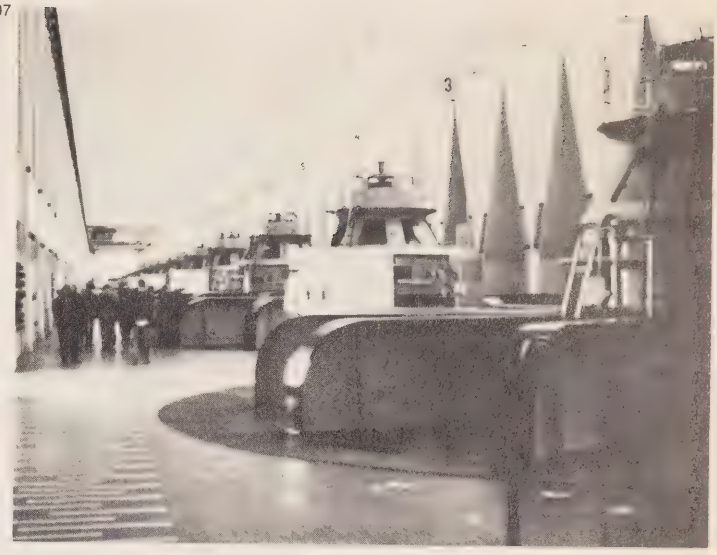

Turbines and Generators

Eighteen units (ultimately these will be 20) with radial-axial turbines of 230-250 thousand kW capacity are installed in a 500-metre-long power house. The Bratsk hydro-electric station generating units are second only in power to the units of the Krasnoyarsk hydro-electric station. There are two 350-ton overhead travelling cranes in the station for the erection and maintenance of generating units.

Turbine Specifications	
Type	Vertical-shaft radial-axial
Capacity,	230 mW
Design, head,	100 m
Turbine discharge at design head,	254 cu. m/sec.
Runner diameter,	5.5 m
Speed,	125 rpm
Efficiency,	93%
Weight of runner with shaft,	130 t

Generator Specifications	
Type	Vertical-shaft synchronous
Capacity,	225 mW
Power factor,	0.85
Voltage,	15.75 kV
Excitation system,	ionic

108 Airport terminal building at Norilsk.
109 Downtown Norilsk.
110 Main street in Norilsk. Utilities are located under boulevard. (See Appendix 8.)

Reservoir
An artificial lake with storage capacity of 169.4 cu. km. was created. The water table area of this storage reservoir is 5,470 sq. km.

The drawdown of the storage reservoir can reach 10 m. An additional 1.5 m of water can be used for flow control from the Irkutsk hydro-electric station storage reservoir, upstream of the Bratsk project on Lake Baikal.

Economic and Technical Indices	
Average annual electric power output,	22.6 billion kWh
Average annual number of hours per kW of installed power	5,510
Operating personnel (including repair teams) per 1,000 kW of installed capacity,	0.02 (men)
Cost of one kW of installed power,	143 roubles
Prime cost of one kWh,	0.005 kopecks

Norilsk

37 General Information

While at Norilsk, the group visited the Medvezhi Ruchei open-pit mine, the concentrating plant, the power system control panel, the nickel electrolysis plant, new housing construction, kindergarten–nursery school, the Valek medical centre, and the Messoyakha–Norilsk gas line.

During the visit the following people were met:

Kolnikov, B. I.
Chief Engineer of Zavenyagin Mining-Metallurgical Kombinat

Zhmurko, P. T.
Deputy Director (Mining) of the above-mentioned

Burkhis, Y. B.
Deputy Chief Engineer of the above-mentioned

Muravyov, D. M.
Director of Construction Department of the above-mentioned

Kolyada, V. I.
Deputy Director of Construction Department

Deyev, V. I.
Mayor of Norilsk

The population of Norilsk, including the surrounding settlements and Talnakh, is approximately 155,000. The Norilsk regional council, responsible for the entire area, is made up of 350 elected delegates. The city council is responsible for the construction, services and operation

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111-113 Medvezhi Ruchei open pit mine.

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of the city of Norilsk and is composed of 15 officials: a chairman, two deputy chairmen, a secretary and 11 councillors. The council usually meets twice a month and its annual budget is 28 million roubles.

A railway was built in 1937 from the Yenisei port of Dudinka to Norilsk. When a new deposit was opened at Talnakh, 15 miles north-west of Norilsk in 1967, the railway was extended there.

A coal-fired thermal power station was built in 1942 and is now being converted to gas, supplied from the Messoyakha gas field. Electricity is also being provided from the Khantayskaya hydro-electric project, completed in 1970. These two sources supply all the power required at the mine, mills and town site.

38 Medvezhi Ruchei Open-Pit Mine

A mineral deposit of polymetallic ores, containing copper, nickel and platinum was discovered in 1922. The Soviet Government decided to build a modern metallurgical combine at Norilsk in 1935. Permafrost in this region goes to a depth of 250 meters. This huge open-pit mine is approximately five kilometers long with a design depth of 500 meters of which a depth of approximately 200 meters has been reached. The ore, containing copper and nickel, is said to be 1/6 to 1/10 the richness of Canadian ore, but contains platinum thus improving the overall grade. The ore is drilled, blasted and loaded into waiting trains by shovels with a capacity of eight cubic meters.

Railway cars and 40-ton trucks transport the ore to the processing plant. The drilling rigs (270 mm diameter drills) drill 3,500 to 4,000 meters a month.

The ore is crushed by rod and ball mills and concentrated by flotation process. In one area of the plant 840 flotation cells were observed (Hill). Nickel is produced from nickel sulfide anodes at the nickel electrolysis plant. This process eliminates costly oxidation and reduction operations in preparing the nickel sulfide for refining.

39 New Housing Construction

A new housing site was visited on Lenin Prospect. Buildings of five storeys were being constructed on piles 12 meters long with a cross-section of 40 cm square. The distance between the piles was smaller than that in Yakutsk. Air space under the buildings was also less than that found in Yakutsk and there were air intakes in the foundation wall. The soil in Norilsk was silty clay and there was a fine-grained soil throughout the entire area. The site was covered with slag to a depth of one metre supplied from the mill and mine before construction. Many buildings had brick, load-bearing exterior walls.[32]

The same drilling procedure for piles is used as in Yakutsk, and they are loaded two or three days after placement in winter and after 10 days in summer. Instruments are installed in the base to measure temperature variations. All buildings in Norilsk are on piles in permafrost or on foundations if on bedrock.

[32]See Appendix 8.

114-115 View of city from the mine.
116 View of the mills.

117 Construction of new suburb in Norilsk.
118 Brick construction.
119 New construction.

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120 Rigs used to drill holes for piles in the permafrost.
121 Day care nursery facilities.
122 Hallway of the nursery.

123 A nursery attendant taking the children for a walk.
124 Valek health centre.
125 Gas pipeline construction outside Norilsk.

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126 Towers for pipeline roadway crossing being erected.

127 Zig-zag construction of gas pipeline to allow for expansion.

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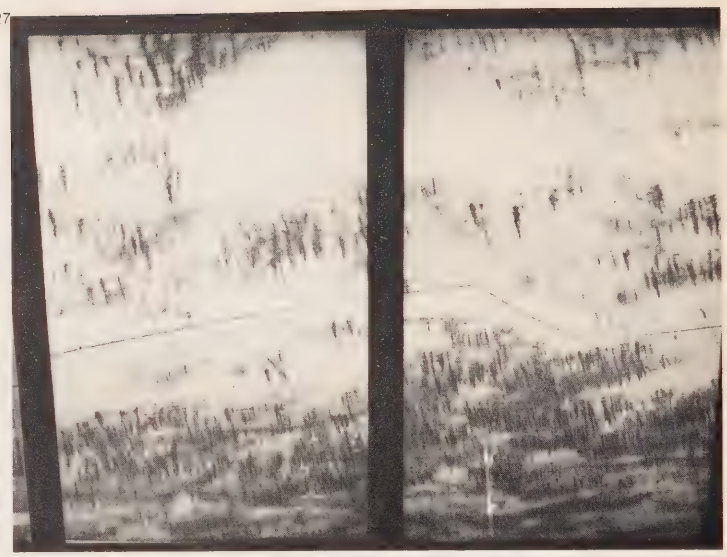
127



40 Social Services

Kindergarten and Nursery School

The large kindergarten–nursery school provided education and day nursery facilities for children six months to six years old. The school was able to cope with approximately 800 youngsters. The cost per pupil was 1,000 roubles a year of which parents paid 100 roubles. The metallurgical combine was responsible for providing these facilities.

Valek Medical Centre

This centre was approximately five miles from Norilsk. It provided health services and preventative medical care for workers in the area. It was planned to counter the effects of darkness and isolation, and the consequent poor health suffered by many workers.

The centre served 3,500 persons a year at a cost of 17 roubles a person for 24 days. The remaining operating and administrative costs were borne by the Norilsk combine. Apparently 20 per cent of the people using the centre received free service.

In addition, the combine provided a health centre at Sochi for 12,000 workers a year, and at Dudinka for 1,200 workers a year.

41 Messoyakha-Norilsk gas pipeline

Construction on the pipeline from Messoyakha to Norilsk began in 1960. It is 240 kilometers long, of which 10 kilometers is underground. The diameter of the pipe is 720 mm (28 in.) with a wall thickness of 9 mm for above-ground construction and 11 mm wherever it is buried. It operates at 55 atmospheres and has been tested to 60 atmospheres. The operating loop stress is 80 per cent at yield point and the yield strength is 75 kilograms per sq. cm.

The pipeline is of zig-zag construction with 18-degree bends every 450 meters. Above the ground it is placed on a sliding saddle supported on sleepers. The sleepers rest on a small surface pad of sand and gravel or wood cribbing. Pile supports are used for difficult permafrost soils and extreme low temperatures. The steel in the pipe for use above ground is five per cent nickel alloy, which is suitable for operating at temperatures to –50°C. The optimum design for pipes of larger diameter, however, would entail the use of a small angle and a larger distance between bends. No compression is employed and the pipeline operates on natural well pressure. Consequently, there is no need to cool the gas to prevent thawing of the permafrost.

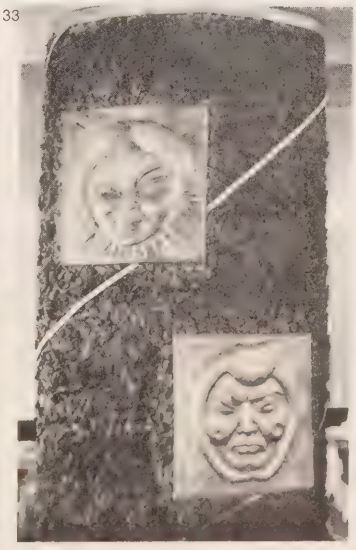
The gas arrives at Norilsk at the temperature of the outside air. If it is very cold the gas is heated to a minimum of minus 10 degrees centigrade before distribution throughout the city. A distribution line approximately 12 inches in diameter was observed under construction in a suburb of Norilsk. The pipe was about 20 inches above ground-level on saddles resting on two short concrete beams embedded in small slag pads.

Some work was also observed where the main line from Messoyakha was being looped. Discussion on the need for looping indicated it was only to ensure continuity of supply. It was impossible to weld the pipeline at temperatures below –40°C, but pipeline construction was carried on during the winter to minimize surface disturbances.

Overhead pipeline river crossings 90 feet long had no visible supports. (Hill).

128 New restaurant recently built in Norilsk.
Name of restaurant is "69th parallel".
129 Mural inside restaurant.
130 One of the official hostesses who greeted us at the restaurant.

131-133 Native art.



Part V Statement

by The Honourable Jean Chrétien
Minister of Indian Affairs and Northern Development
to Mr. I. T. Novikov, First Deputy Chairman of the Council of Ministers and Chairman of GOSSTROI of the USSR
Moscow, August 4, 1971

Mr. Chairman, I have returned to Moscow and am meeting you today after what was certainly one of the most interesting and successful visits I have ever made. This is the first official Canadian delegation to your country since Prime Minister Trudeau came here in May of this year and signed the Canadian-Soviet protocol on consultations with Premier Kosygin. As a direct follow-up to that understanding, I must tell you that in my view the visit has been most successful and I hope that you also regard it in the same light.

First I must thank you, Mr. Chairman, for having arranged an itinerary which included many items of great interest to me and my colleagues. I say this knowing that your organization is primarily responsible for construction matters throughout the Soviet Union, and that it was therefore necessary for you to make special arrangements for us to meet with a wide variety of local and regional governing bodies, scientific and research institutes as well as native groups. My delegation was highly specialized and you understood very well the nature and variety of our interests. As a result it was a very long trip–some 16,000 kilometers in Siberia and we have several thousand before us before we reach home. But we stood up well, and always at the end of a long day's journey there was a warm welcome and excellent hospitality.

The time available today does not permit me to mention by name all those who extended hospitality to us, but I want to recognize the special welcome extended by First Deputy Chairman Ignatiev of the Council of Ministers of the Yakutian Soviet Socialist Republic and the wonderful people we met on the tundra north of Cherski who looked after us so well. Indeed, I was made to feel at home in Yakutia and was able to establish a warm personal contact with the First Deputy Chairman and many of his associates.

Although I would like to mention by name all those who looked after us at each stop on our trip, I must make special mention of those who assisted us on our tour. I refer, of course, to Vladimir Yermolenko who guided us throughout; Eugene Sergeev whose unfailing sense of humour and fluent translation in English and French helped us bridge the language barrier; and to Boris Sadovski who was a welcome addition to our group in Yakutsk.

I expect that you would like to hear about a few of the impressions we gained on the trip which, naturally, I shall take back to Canada with me. I have already mentioned the warm hospitality, but in addition want to note the friendliness of all the people we met, whether they were acting in an official capacity or simply individuals we met in a store, restaurant or on the street. They were all interested in us, in what we were doing here and in Canada. The emphasis placed by everyone on co-operation and increased bilateral exchanges was most encouraging, and I should like to assure you, Mr. Chairman, that Canadians share in full measure these sentiments.

The vast size of your country is bound to impress anyone, even a Canadian who is used to long distances and large vistas. However, there is no doubt that in your combination of air and water travel you have developed a transportation system which is adequate to meet the situation. We were particularly impressed with the river transportation system and the extensive facilities we were able to observe on the Lena River at Yakutsk and on the Kolyma River north of the Arctic Circle at Cherski.

Since we have only one river system in Canada flowing "down north", the Mackenzie, I must say I am even more appreciative of the way in which nature has come to your assistance–not only in the matter of water transportation, but also in natural resources. We saw only a sample of what you have found and developed to date, but even this was sufficient to impress upon me the vast wealth of Siberia.

We saw hydro-electric developments, mining, natural gas, forest industry, and even industry based on traditional pursuits, such as fishing and reindeer-herding. In this respect our visits to the hydro dam built on permafrost at Chernyshevski and the gas pipeline at Yakutsk and Norilsk were of very great interest to me and to the members of my delegation. It was encouraging to find that the line at Yakutsk had been operating for up to four years without any difficulty, and this in spite of the fact that, in part, the lines are above ground on concrete supports and, in part, buried in the permafrost. On the portions we were able to observe, there appeared to be no environmental damage and good re-establishment of the vegetation.

I was also interested to learn that you expect to increase your exports of various materials such as natural gas, since I believe that trade on an international basis leads to increased goodwill and co-operation among nations.

Everywhere we went we saw construction taking place, both industrial and housing: we visited cities, large by Canadian standards, such as Mirny and Chernyshevski, which have been built in the last 15 years, and we saw several industrial complexes in the making. There is no doubt that Siberia is on the move and that your country can be justly proud of what has been achieved to date. We saw the country in summer when nature is kind and for a few short weeks man can relax in his struggle to develop a harsh land: but as Canadians we know something of the rigours of winter and, therefore, to us your achievements are all the more impressive.

The number and size of your various institutes and scientific organizations were also noteworthy. Of particular interest to us was the Arctic and Antarctic Institute in Leningrad, and the Academy of Sciences and the University at Yakutsk. This latter is a remarkable achievement, and I am sure there would be some Canadians who would like to have the opportunity to study Arctic problems north of the Arctic Circle in Yakutia.

The participation of your native peoples should also be mentioned, since we appear to share the same objectives of encouraging our native peoples to play an important role in the development and government of our countries.

I could continue with my impressions of the trip for some time yet, but now, unfortunately, we must prepare to return home, so I must bring this portion of my remarks to an end. Aside from the main objectives of my visit, there were two experiences which to me were personal in nature and on this basis will remain as highlights of my visit. The first was the time we spent in Leningrad, which must surely be one of the finest and most impressive cities in the world. The other highlight was the night we spent on the tundra with the magnificent Chukchi herdsmen and their families as our hosts. The open tundra, the skin tents, the four or five different ways of preparing fish, and above all the companionship, will always remain in my memory.

But all the things we have learned and the impressions we have obtained must form the basis of continued and regular exchanges between our two countries if their worth is to be realized.

I note with pleasure that several areas of interest are already included under the agreement on the industrial application of science and technology, signed in Moscow earlier this year. I hope that co-operation in the fields of hydro-electric dam construction on permafrost, building construction in the far north, and gas pipeline construction on permafrost will move forward quickly in this manner.

With respect to the gas and oil working groups formed under that agreement, it is our feeling that the greatest benefit would be obtained if the oil working group were to meet in Canada and the gas working group in the Soviet Union as soon as possible.

I am also pleased that I was able to reach an agreement with Mr. Yefremov of the State Committee on Science and Technology to establish a working group on Arctic scientific research. In this connection, we shall be interested to explore further the suggestion of Mr. Yefremov with respect to joint scientific expeditions in the north.

Taking into account all those fields in which co-operation seems to be assured, it still appears to me that we could give consideration to ways and means of assuring co-operation in the broad field of Arctic development which would include, essentially, all activities taking place in the far north. We are, after all, neighbours across the Pole and as such have many common interests. We both have tundra, native peoples, a harsh climate, long distances, and a frontier area to develop. Thus we have a special basis for working together—we should profit from each other's successes and learn from our experiments. I would like to see us work together in fields such as cultural development, special education for northern peoples, natural resource development, northern science research, northern transportation and many others.

Several areas of immediate mutual interest come to mind: perhaps observers from Yakutia might come to our Arctic Winter Games to be held in Whitehorse in March 1972; we might exchange information on the establishment of wilderness areas and methods of assessing the extent to which they can be visited by the public without harm; we are now in a position to start working on a Soviet request that Canada supply a small group of muskox as a base for re-establishing the species in the Soviet Union; finally we would be happy to make available to the Soviet public later next year a display of Eskimo art known as the Eskimo Masterworks Exhibition. Also of interest is the suggestion that a twinning arrangement should be developed between the cities of Norilsk and Inuvik.

I trust that Canadian-Soviet contacts in the future will extend to cover the field of northern development in the broadest sense, and to that end I know you will want to see something of the Canadian north and its people. The Canadian Government would be pleased to welcome a delegation from the Soviet Union having this broad objective in mind.

In conclusion, Mr. Chairman, I can only say a simple "thank you" to yourself and the Soviet Government for having provided us with a stimulating and interesting visit to your country: particularly to that part of Siberia north of the Arctic Circle, and to express the hope that our visit has conributed towards increased mutual understanding between our two countries, and that it will pave the way for expanded co-operation in the future.

In reply Mr. Novikov thanked Mr. Chrétien and briefly outlined the policies of the Soviet government for the development of Siberia.

Plans call for future expansion of power supplies by developing 22,000 megawatts of electricity, construction of 1.5 million-volt transmission lines and the movement of electricity to the west in the next five to 10 years by a grid system so that peak loads can be dealt with evenly throughout the country. The oil and gas industry will be expanded to provide not only for the demands of the country but also for the rest of Europe. A 1,424 mm pipeline, operating at 75 atmospheres, is being built from Tyumen to West Germany and other European countries. Mr. Novikov showed no concern about running short of gas since he estimated that Soviet gas reserves run into the hundreds of trillions of cubic meters which should last for at least the next 100 years.

Part VI Summary and Conclusions

This final part is divided into the following five sections: social and economic development of native people, oil and gas development, construction, hydro-electric development, and exchanges.

1 Social and Economic Development of Native People

Summary

The Soviet North is entirely in the Russian Soviet Federated Socialist Republic and is inhabited by many nationalities and ethnic groups of the Soviet Union: the Komi, Yakuts, minority peoples of the North,[33] as well as the Russians, Ukrainians and Byelorussians. The minority peoples of the north number approximately 140,000 and include such groups as Aleuts, Chukchi, Dolgans, Entsy, Eskimos, Evenks, Evens, Itel'men, Kets, Khants, Koryaks, Mansi, Nanays, Nentsy, Nganasans, Nivkhis, Saams (Lapps), Sel'Kups and Yukagirs. In addition the Amur people have, at times, been included within this group.

Most members of each indigenous group speak their own language, but it was stated that the majority are also fluent in Russian. The native people work in government and industry in such professions as medicine, teaching, and administration, but most are engaged primarily in the traditional pursuits of hunting, fishing and reindeer herding.[34] Native people enjoy all privileges accorded any other Soviet citizen, including the special northern pay increments and regional bonuses, either of which may be as much again as the basic salary, but will not exceed 300 roubles a month even in the extreme north.[35]

There are 10,000 persons (out of a population of 140,000 of the minority peoples) in the reindeer herding industry and the greatest number are employed as herders looking after 2½ million domesticated reindeer. A herder's income, including northern increments and bonuses, varies from 200 to 400 roubles a month, and in addition he receives free clothing and meat at cost.[36] Reindeer herders are being converted from full- to part-time nomads, following herds for a two-month period and then spending the rest of their time in villages working on state farms, construction, or on their own private plots of land.

There are between 10,000 and 12,000 hunters combining hunting with trapping, fishing and fur farming. The guaranteed minimum wage is between 100 and 120 roubles a month and, including northern increments and regional bonuses, can range from a minimum of 130 roubles to a maximum of 1,000 roubles a month.[37] A bonus is paid to trappers and hunters for whatever they catch in excess of the established norms. In order to ensure that a hunter works at his maximum effort the following steps are taken by each sovkhoz:

- control and norms are established by fellow hunters;
- each hunter is encouraged by a system of bonuses to catch as many animals as possible;
- each hunter is regarded as a professional man and
- receives a guaranteed minimum monthly wage.[38]

Nomads are encouraged to establish themselves in settlements, and between 1952 and 1970 approximately 12,000 families, or between 52,000 and 75,000 persons, were relocated in villages and towns. Many have been lodged in large apartment buildings which has resulted in certain social problems associated with moving migratory people into permanent quarters.

[33] Soviet scholars refer to these smaller groups of indigenous people as "lesser nationalities" while western scholars usually call them "small peoples".

[34] Most of the ministers in the Council of Ministers of the Yakut ASSR were Yakut. Similarly, the directors of the Yakut State University and the Yakutsk Branch of the Academy of Sciences and a number of their staff were Yakut.

[35] See Maps 5 and 6.

[36] A. P. Roslyakov, writing about the reindeer industry in the Taimyr Okrug, states: "The wage fund for the team of herdsmen is determined from the six-scale pay system in force in the Kolkhoz, according to which reindeer herding is in the fifth-scale with a basic pay of 70 roubles a month, multplied by a bonus factor of 1.6 applicable to this zone, making it 112 roubles. The team leader receives an increment of 25 per cent of the basic scale and his assistant 10 per cent. Subsequently, the monthly pay of the team leader is 140 roubles (112 roubles x 1.25) the assistant 123.2 roubles (112 roubles x 1.10) and the herdsmen 112 roubles (112 roubles x 1)".
In picking out the best year for a team between 1964-1966, the distribution of income within the team was as follows: the team leader received 2,262 roubles, the assistant 1,991, and the herdsmen 1,810 roubles each.
A. P. Roslyakov "Cost Accounting in Kolkhoz Reindeer Husbandry". *Problems of the North* No. 13, 1968. Translation, September 1970, pp. 135-142.

[37] This maximum of 1,000 roubles would appear to be the exception. A. Mukhopad reporting on hunting and reindeer breeding in the Evenki National Okrug states: "The majority of the native population live in kolkhozes. The income per family unit has increased from 1,216 roubles in 1957 to 2,224 roubles in 1967, i.e., 84.9 per cent, and the income per able-bodied kolkoz member has increased from 865 to 1,569 roubles, i.e., by a factor of more than 1.8."
A. A. Mukhopad. "Development of Wild Pelt Production in the Evenki National Okrug". *Problems of the North* No. 13, 1968. Translation, September 1970, pp. 159-164.

[38] V. D. Skrobov, in describing Arctic fox harvesting in the tundra, states: "There are still shortcomings in the organization of the Arctic fur harvest and in paying for labour. The pay received by kolhoz trappers does not provide sufficient incentive to ensure increasing production. In our opinion the pay system should be such as to give the hunter, for his not particularly easy work, at least 80 per cent of the pelt value. In a number of cases the trappers maintain their transport animals equip themselves with hunting clothes and other small items at their own expense, and build and equip their own shacks. All the equipment necessary for their trade and transport should be provided by the economic unit." V. D. Skrobov "Arctic Fox Harvesting in the Tundra" *Problems of the North* No. 13, 1968. Translation, September 1970, p. 190.

Government officials are also trying to preserve the traditional occupations of herding and hunting. For individuals who cling to the traditional way of life, the state is making an effort to improve their living and working conditions both in the settlements and in the field.[39] One such attempt has led to the provision of temporary settlements in the tundra and the use of portable trailer-type homes in order to make life easier for the hunter and the herder.[40] Free medicine is provided, and to encourage local population growth a bonus of 150 roubles is paid upon the birth of the first child. For an individual who wishes to build his own home 75 per cent of the cost is paid by the state.

The preservation of local culture is important. The government supports local newspapers, and radio stations and organizations are conducted in local languages.[41] There are TV stations in far northern regions offering local programs as well as programs relayed from Moscow and the rest of the Soviet Union by the ORBITA Satellite.[42]

Conclusions

- The guaranteed minimum monthly wage, the acceptance of hunting, fishing and herding as full-time professional and not seasonal occupations, and the control, set-up and regulation of the norms by each local council are positive aspects of the Soviet approach to these traditional pursuits. Undoubtedly, there are a great number of unresolved problems, but the fact remains that the exchange of information, specialists and native hunters in areas related to the fur industry would be beneficial to both countries, particularly to Canada.

[39]The various problems associated with hunting are discussed in several articles in *Problems of the North*, No. 13, 1968. Translation, September 1970. It is obvious from the articles that a greater effort is required to improve conditions. V. A. Tavrovski "Some Problems in the Development of the Fur Industry in Yakutia" pp. 151-158.
V. D. Skrobov and F. I. Khudoleev "The Hunting Industry on Yamal and Ways of Increasing its Productivity" pp. 165-174.
V. D. Skrobov "Arctic Fox Harvesting in the Tundra" pp. 185-191.
I. P. Avdeev and K. G. Kondakov "An Integrated Solution to current Problems in the North" pp. 327-333.

[40]The tents of the Nizhnekolymsk Sovkhoz visited by the delegation were of the traditional type.

[41]Most posters that were seen in Yakutsk were in the Russian language. In Cherski, however, there were posters which were either in Yakut or Chuckhi.

[42]Yakutsk was the only town in northern Yakutia where an opportunity arose to watch television. The hour of TV programming seen in Yakutsk was in Russian.

- Information on Soviet fur ranches which specialize in the breeding of blue arctic fox would be useful for determining whether such an operation would be economically sound in northern Canada. Throughout the visit, Soviet officials stressed the importance of fostering local indigenous culture, especially through the use of local radio and TV. Although time prevented an appreciation of Soviet initiative in this area and the availability of television at various settlements, it seems reasonable to accept that the use of local radio and TV and the Orbita satellite to provide communications to remote areas would have the positive effect of bringing various native groups closer together and of making them proud of their heritage and also of their country.
Education plays a major role in the development of the Soviet North and is, therefore, one of the more important areas in which the Department of Indian Affairs and Northern Development could have an active exchange with certain agencies in the Soviet Union, particularly those in the Soviet North. This would include the exchange of educators, native people and information in such areas as local languages in schools, adult education, vocational training, training for traditional occupations, special curricula etc.

2 Oil and Gas Development
(based on information provided by C. R. Hetherington, President Panarctic Oils Ltd.)
Summary

The Soviet Union has very large reserves of oil and gas and the ultimate potential reserves are probably larger than those of North America. Present gas reserves are considered to be about 400 trillion cubic feet and the 1970 gas production of seven trillion cubic feet indicates a reserve production life in excess of 50 years. The newest gas province, i.e. the Yakut ASSR, has a known reserve of 21 trillion cubic feet with a potential reserve of 450 trillion cubic feet. Non-associated gas reserves are essentially pure methane.

Very large reserves of oil and gas have been developed in the Tyumen area and in Central Asia. No significant oil discoveries have been made in the far northern areas of Siberia.

Present fossil fuel policy in the Soviet Union reflects a strong preference for gas and oil over coal because of lower production and shipping costs, and a further preference for natural gas over oil. Accordingly, large-diameter pipelines of up to 56 inches are planned from the Ob River area to European Russia, and the East European Countries as well as to West Germany. This system, 2,500 miles in length, is scheduled to go on stream by 1973. Gas exports of 950 billion cubic feet a year are planned by 1975.

Pipeline policy also provides for security of supply by building duplicate loop lines rather than a single pipeline,

along with underground storage closer to the market areas. Gas is used principally as an industrial fuel which will eventually replace coal. Essentially, no gas is used for residental purposes other than in large central heating installations.

Large quantities of gas are to be exported, and there does not appear to be concern about running short for domestic needs. This decision appears to be based on anticipated rather than known reserves. Further, there are limitless quantities of coal which could be used as such or converted into gas, and present planning aims at making atomic energy the principal fuel of the future. Present policy is to produce gas from the less remote areas of the Tyumen region and along the Ob River while exploring and developing the more northerly areas for future use.

There seems to be a great concern about supplying energy to expanding industries. Policy appears to be based on the immediate need to supply fuel to the various industrial and residential centres and to deal with any problems as they become apparent. The principal concern of pipeline research is to develop technology both for the construction and operation of pipelines in order to provide reliable sources of supply.

There are two gas pipelines in the Arctic constructed entirely over permafrost: the 250 miles of 20-inch and 12¾-inch diameter pipeline to Yakutsk and the 150 miles of 28-inch diameter pipeline to Norilsk. Both are in operation and apparently few difficulties have been encountered. Various types of construction are employed, including pipe buried underground, pipe laid on the ground and covered with a berm, and pipe supported on piles. Expansion in above-ground pipelines is provided for by both expansion loops and zigzag-type construction. Special design problems are being worked out for the planned 56-inch diameter pipeline and more information on the details of this design would be of interest.

The Soviet Union has, as yet, no experience in the handling of crude oil under Arctic permafrost conditions.

The Siberian North is accessible by way of many large navigable rivers along which drilling equipment and supplies are transported to the production areas. In the Siberian North drilling operations are carried on only during winter when the ground is frozen. No drilling has been undertaken in the Arctic Ocean.

Conclusions

- The oil and gas resources of the Soviet Union are tremendous and the ultimate potential is probably much larger than that of North America. Certainly the potential for natural gas appears to be greater than in North America.

- The oil and gas industry in the Soviet Union is well advanced and domestic needs are being met. Oil is being exported and large quantities of natural gas will also be marketed abroad within the next few years.

- Although equipment, construction technology and methods of operation do not, in general, meet North American standards, the work is satisfactory. However, while we may not be learning from a technology more advanced than our own, we will benefit by discovering how Soviet energy needs are met.

- Undoubtedly there is concern for protection of the ecology in the Soviet Union, but such concern is secondary to the main objectives of achieving present quotas for oil and gas.

The visit to the Siberian North was of immense interest to Mr. C. R. Hetherington and his observations led him to conclude that:

> "The oil and gas industry in the Soviet Union has made tremendous practical advances in discovering reserves, completing wells and delivering oil and gas to market. Further investigations into these very substantial achievements can be of assistance in guiding the development of our North.
>
> A further point of interest was the occurrence of very large dry-gas fields in the Soviet Arctic which produce from the same geologic formations in which both gas and oil discoveries have been made in the Canadian Arctic Coast and Arctic Islands. The geological similarity and the similarity in size of individual fields gives encouragement to oil and gas exploration in the Canadian North."

3 Construction

(based on information provided by Mr. A. St-Amant, of St-Amant, Vinet, Brassard, Consulting Engineers)

Summary

Construction costs in the far north are higher by a factor of 2 to 8 (depending on the isolation of a particular project) than for similar projects in European Russia. In order to reduce these high costs most structural elements such as reinforced concrete panels and piles, wooden door and window frames, windows, doors, and hardware, are standardized prefabricated in factories and transported, sometimes over great distances, to the construction site. The designs of apartment buildings are also standardized, and the one most accepted is a five-storey, peaked-roof structure.

In the far northern settlements steel and aluminum may be used as construction materials but, as in the southern regions, precast concrete is preferred for the following reasons:

- Steel and aluminum are in short supply, at least until the end of 1975. Moreover, construction using these materials calls for skilled labour which at present is very scarce in the Soviet Union, and especially in northern regions.

- Although brick is the traditional building material, it also requires skilled labour. Northern conditions also preclude all-year construction with brick as the primary building material.

- Use of poured concrete has to be limited to only three months in the far north, which in turn imposes a severe restriction on the construction of buildings.[43]

The alternative is to use precast building elements as much as possible since precasting "requires less labour while allowing closer quality control, greater speed of construction, year-round component production in the factory and year-round construction at the site."[44]

[43]James R. Wright, Editor. *Industrialized Building in the Soviet Union* (A Report of the US Delegation to the USSR National Bureau of Standards Special Publication 334, May 1971, p. 25.

[44]Wright, p. 25.

All buildings of two or more storeys are built on piles in permafrost regions. The length of pile in permafrost is at least five meters but may be as much as six depending on the applied load on each pile. In northern regions the construction of buildings, including the drilling and placing of piles, is continued throughout the year in spite of severe winter conditions.

In assessing the special project in Yakutsk which is an office building being constructed on permafrost for the Council of Ministers, the total estimated cost was 2,500,000 roubles for 5,735 sq. m of office space, or approximately $44.55 per square foot. Construction time was estimated at two years and the time spent in preparation of all drawings and plans was nine months, with seven to eight persons working on the project. Cost per cubic meter was 120 roubles or approximately $3.75 a cubic foot.

Conclusions

- Soviet achievements in construction in Siberia, especially in its northern areas were most impressive. There is no doubt, from the various projects visited, that Soviet engineers are among the best trained in the world and are able to produce quality work in such major projects as the dam at Chernyshevski or the Bratsk hydro-electric project and Forest Products Complex. The general construction of dwellings, servicing facilities, industrial plants and factories, and roads, however, show the difficulty of maintaining high standards in northern conditions. In an attempt to speed up construction, quality has generally suffered and undoubtedly, in the long run, will require additional amounts of time, money and labour. Compared to construction in the Canadian North, it is obvious that the Soviet Union leads in the quantity of construction of various housing and industrial projects but not necessarily in the quality of construction.

- In future exchanges with the Soviet Union information can be traded in such specific areas of construction as:
  - main principles of planning and provision of utilities in apartment buildings in the Arctic;
  - construction of pile foundations in permafrost;
  - stability of heat-emitting structures on permafrost.

- Light-weight building materials will continue to be used in northern Canada since they are more economic, easier to transport and much simpler to erect. The use of these materials and also the use of ATCO-type trailer homes will undoubtedly continue to be specific areas in which construction agencies of the Soviet Union will show the greatest interest. In addition, Soviet engineers will be interested in following Canadian design and construction of roads built on permafrost.

Map 11
Main Hydro and Thermal Power Stations

---- International Boundary

1 Thermal Power Stations (Over 1mkW)
2 Selected Smaller Thermal Stations
3 Hydro-electric Stations (Over 500,000 kW)
4 Selected Smaller Hydro-electric Stations
5 Atomic Power Station
6 Thermal Power Station Under Construction
7 Atomic Power Stations Under Construction
○ Hydro-electric Stations Under Construction

4 Hydro-electric Development

(based on information provided by J. M. Lowe, General Manager, Northern Canada Power Commission)

Summary

Bratsk

The most impressive characteristic of the Bratsk hydro-electric station is its size, and its 5,000 MW output. The station is standard in virtually all respects and therefore is not of particular interest to the Northern Canada Power Commission.

Chernyshevski

There are several interesting aspects in the construction of this power station, mainly because of its far northern location and relative isolation. Features of particular interest are:

- Construction in a permafrost region even though all structures are found on rock. Rock has fissures containing ice and grouting is necessary concurrent with melt.
- The unorthodox achievement of placing the dam core during winter.
- The fish-handling facilities are also considerably different from those in Canada where costly collector systems and fish ladders are generally used. At this site, however, a fish-gathering system has been installed downstream and, in conjunction with a hatchery, small fish are placed in the reservoir upstream of the dam. The need for fish ladders is eliminated.
- Clearing of the reservoir was confined to an area immediately upstream of the dam for a distance of 20 miles. The result of flooding timberland upstream and its particular effect on marine life, would be useful in appraising future projects of this sort in Canada.
- Spillways at the site consist of only one very large gate of the Tainter type capable of passing a 100-year flood of 13,000 cubic meters a second. One of the reasons given for preferring the single spillway gate as compared to several smaller gates, is that very large debris can pass through the spillway.

Cherski
The town is supplied by a three- or four-unit slow-speed diesel-electric station. The port town of Zeleny Mys used a twin gas-turbine installation (two 10 mW machines) housed on a barge. There was some question as to the type of liquid fuel being used in these gas turbines and it was not ascertained whether this was a light or heavy fuel.

Although the diesel plant in Cherski was not examined, the station did have all the appearances of being a standard installation.

Yakutsk
A large gas-turbine station was under construction on the outskirts of Yakutsk. This station has four units, two of which are being installed now. Of the original two units one was operating at a fairly light load during the visit. This station uses natural gas as a fuel and appeared to have waste-heat recovery facilities for supply to the central heating system of the area. There was nothing unusual about this station as compared to North American practice.

Conclusions

- Hydro-electric stations continue to be the major source of electricity in Siberia, while thermal power stations using diesel fuel, coal and gas are secondary sources of power. As gas fields develop in the north, there is no doubt that gas thermal-electric stations will replace coal and steam thermal-electric stations. Atomic power stations will also become important in northern areas, especially if the station at Bilibino meets Soviet expectations.

- At present the power potential of Siberia is being developed to meet local needs, but with a view to supplying some of the future power needs of European USSR. The final goal will be a unified power supply system throughout the Soviet Union which will eventually consist of four or five connected super-grids stretching from the Pacific to the Baltic Sea.

- In any exchange of information between Soviet and Canadian engineers on hydro-electric development it appears that, at present, it will be primarily between the various hydro-electric commissions in the provinces and in the Soviet Union. Most hydro-electric projects in the Soviet Union are designed on a scale the size of which is not contemplated by the Northern Canada Power Commission in the near future. There is no doubt, however, that hydro-electric, thermal and atomic-electric projects designed for and operating in Soviet permafrost regions will be followed with great interest by members of the Northern Canada Power Commission.

5 Exchanges
Summary
Since the early '60s the Department of Indian Affairs and Northern Development has wished to pursue an effective exchange program with the USSR, especially in the areas of socio-economic development and scientific and technical research. In 1965 the then Minister of Northern Affairs, the Honourable Arthur Laing, accepted an invitation to visit the USSR. A Soviet delegation, made up primarily of representatives from GOSSTROI, visited northern Canada in the following year and an informal agreement was reached with GOSSTROI which resulted in:
- extended visits of two permafrost specialists from Canada to the USSR in 1965, and from the USSR to Canada in 1967;
- a visit by a party of specialists from GOSSTROI in 1967.

After a detailed review of the department's policy on exchange programs with the USSR, it was concluded in December 1969 that an effective exchange program with the Soviet Union would be beneficial not only to the Department of Indian Affairs and Northern Development, but to Canada as well since the Soviet Union and Canada are the two largest nations in the world with sizeable territory north of the Arctic circle. There was no equivalent to the Department of Indian Affairs and Northern Development in the USSR. Any effective exchange program would, therefore, have to include the Council of Ministers, USSR and RSFSR; State Committee for Science and Technology; State Planning Committee (GOSPLAN), GOSSTROI, and other committees and commissions dealing with specific northern problems which have IAND's corresponding responsibilities in the north. The exchange of information and delegations could be in such broad areas as:
- methods of improving socio-economic conditions of the native peoples, and of encouraging the development of native cultures;
- the management and development of the north with a view to enforcing the strongest possible conservation measures and causing the least possible pollution;
- the exchange of technical experience in the design and construction of northern industrial projects, buildings, foundations, pipelines, roadways and airfields.

It was also obvious that an effective exchange program would necessitate the extension of geographic areas which scientists would be allowed to visit both in the Soviet and the Canadian North. All areas in the Canadian North, including the Arctic Islands, would be available for exchange visits by Soviet scientists and delegations.

In January 1971, the Canada-Soviet Agreement for Co-operation in the Industrial Application of Science and Technology was signed by the Honourable Jean-Luc Pepin, Minister of Industry, Trade and Commerce and Mr. V. A. Kirillin, Chairman of the State Committee for Science and Technology of the USSR Council of Ministers. The agreement aimed "at encouraging co-operation between the two countries in the field of industrial science and technology...and could take the form of exchanges of information, and visits of businessmen and experts. It could also lead to licensing agreements in specific areas of technology."[45] Under this agreement, six working groups were formed to identify areas for mutually beneficial exchanges: (1) electric power; (2) architecture, construction and building materials: (3) forest-based industries; (4) the non-ferrous metals industry; (5) the oil industry; and (6) the gas industry. The Department of Indian Affairs and Northern Development has taken an active part in the construction, oil and gas working groups and Mr. A. D. Hunt, Assistant Deputy Minister, is Chairman of the Gas Working Group. In October 1971 the Canadian Government hosted a visit to Canada by members of the USSR oil and gas working groups. The Soviet delegation had the opportunity of visiting oil and gas operations throughout Northern Canada and the Arctic Islands.

While in the Soviet Union, Mr. Chrétien introduced the subject of a joint working group in the area of Arctic scientific investigations. In discussions with Mr. L. N. Yefremov, First Deputy Chairman, State Committee for Science and Technology of the USSR Council of Ministers, it was decided that a co-operative basis to Arctic research was necessary, but the mechanics of the exchange would be determined at a later date. In September 1971, when Mr. Yefremov visited Canada, formation of a temporary working group was agreed upon to determine areas of Arctic research. The group is expected to operate within the framework of the General Exchange Agreement, which was signed in October by Mr. Trudeau and Mr. Kosygin, and would look at areas of Arctic research where co-operation would be possible.

[45]Hon. Jean-Luc Pepin, Minister of Industry, Trade and Commerce, House of Commons, Thursday, February 4, 1971. *Commons Debate*. p. 3057.

Conclusion

In his concluding remarks to Mr. Novikov, Mr. Chrétien stressed the need of working together in fields such as cultural development, special education for northern peoples, natural resource development, northern science research, northern transportation and many others. In a gesture of good will Mr. Chrétien extended invitations to Mr. Novikov to visit the Canadian North and to the Yakut government to send observers to the Arctic Winter Games to be held in Whitehorse in March 1972; promised to expedite as soon as possible the Soviet request to supply a small group of muskox to the Soviet North in order to re-establish the species in the Soviet Union; and made available the display of Eskimo Art, known as the "Sculpture of the Inuit: Master Works Exhibition", to the Soviet people in 1972 in order to provide them with a better appreciation of Canadian Eskimo Art.

One significant aspect of the visit of the Honourable Jean Chrétien was the importance placed by the minister on the Canada-USSR Agreement on the Industrial Application of Science and Technology, the General Exchanges Agreement, and need for co-operation in the area of Arctic scientific research. It was also clear from views expressed by various Soviet scientists and officials during the visit that an effective social, technological and scientific exchange program with Canada would indeed by most desirable.

In conclusion, it may be stated that the major accomplishment of the visit was to advance the importance of the exchange agreements and the viewpoint that there was much that each country could learn from the other, especially in northern development.

Appendix 1

The State Committee for Construction of the Council of Ministers (GOSSTROI USSR)

*(Editorial: Moscow, *Byulleten' Stroitel'noy Tekhniki,* Russian, No. 4, April 1968, pp 4-8)

(Approved by a decree of the Council of Ministers USSR of 26 January 1968, No. 60).

1. The State Committee for Construction of the Council of Ministers is an all-union-republic organ.

2. The basic tasks of Gosstroi USSR are as follows:

–initiate a uniform technical policy directed toward speeding up technical progress in construction and raising the effectiveness of construction;

–improvement of urban construction and architecture, planning and building up cities, towns and rural villages;

–development of science and raising the effectiveness of scientific research, working out the most important overall scientific problems in the field of construction and architecture, coordination of scientific research work performed by scientific organizations and higher educational institutions in the field of construction and architecture, and control of the introduction of achievements of science, engineering and foremost experience into designing and construction;

–improvement of technical and economical standards in construction, organization of development and approval of all-union standardization documents in the field of construction and state standards for construction materials, members and articles and control of their fulfillment; performance of architectural and construction control;

–further improvement of construction design, estimate standards, development of standard designing, extensive introduction into construction of standard designs and members of production, housing, cultural-welfare and other buildings and structures, development together with the ministries and administrations and approval of measures for raising labour productivity and survey-design organizations, as well as organization of development of general layout plans of industrial parks;

–performance of state expert control of designs and estimates for the construction of enterprises, buildings and structures approved by the Council of Ministers USSR;

–development together with ministries and administrations of the basic principles for raising the technical level and industrialization of construction, engineering utilities of cities and other populated places, enterprises, buildings and structures, for the growth of overall mechanization and automation of construction procedures, improvement of the organization of work, specialization and cooperation in construction, for the most economic and efficient growth of the material-technical and industrial foundation of construction;

–development and performance together with the ministries and administrations of proposals for introduction of scientific organization of labour, reduction of costs, reduction of the duration and raising of the quality of construction and for economic incentives in construction procedures;

–performance together with the ministries and administrations (in conformity with approved plans) of scientific and engineering cooperation of the USSR with socialist and other foreign countries on problems of engineering, standard, designing, construction and architecture, and the output of construction materials, members and articles.

3. Gosstroi USSR in its activities follows the laws of the USSR, ukazes of the Presidium Supreme Soviet USSR, decrees and decisions of the government of the USSR and other standard acts, as well as the given Statute ensuring correct utilization of legal codes in organizations, establishments and in enterprises subordinate to the Committee.

Gosstroi USSR generalizes the practice of utilization of legal codes on problems under its management, develops proposals for improving these laws and introduces them to the Council of Ministers USSR for consideration.

4. Gosstroi USSR works out together with ministries and administrations of the USSR, councils of ministers of union republics and approves annual and future plans: standard designing, experimental designing and construction, investigation and generalization of domestic and foreign experience and introduces new machinery into design and construction, overall mechanization and automation of construction and installation jobs, works out new and revises existing standardization documents for construction and architecture and state standards for construction materials, parts, members, sanitary engineering equipment and building tools.

5. Gosstroi USSR in conformity with its fulfilled tasks performs the following:

a) works out together with ministries and administration, scientific research, design and other interested organizations and approves general state norms, estimate norms, rules, instructions, directions, specifications and other standardization documents for construction and design, price lists for installation of equipment, uniform regional unit prices for basic construction and installation jobs, instructions for working out designs and estimates, layout designs and engineering utilities in cities and other populated places and industrial enterprises, output norms of construction machinery and mechanisms; approves state standards worked out by ministries and administrations for construction materials, parts, members, sanitary engineering equipment and building tools;

b) organizes the development of norms of duration of construction of enterprises, buildings and structures, norms for carryover and norms of consumption of construction materials, members and articles for capital construction and approves these norms and standards together with Gosplan USSR;

c) considers inter-branch norms, rules and other standardization documents on problems of designing and construction submitted by ministries and administrations for coordination and approval after approval by the ministries and administrations;

d) organizes the development and when submitted by ministries and administrations also approves together with the State Committee for Labour and wages of the Council of Ministers USSR in coordination with VTsSPS uniform output norms and unit prices for construction, installation and construction-repair jobs, uniform rating-skill handbook of professions of workers taking part in construction and construction-repair jobs, and output norms for designing and surveying jobs; performs methodological guidance in the development of departmental and local output norms and price lists for construction and installation jobs, for which there are no uniform output norms and unit prices;

e) performs investigations on scientific organization of construction procedures, labour and management, improvement of labour conditions in construction and carries out the development of required norms, instruction and directions; generalizes foremost experience and the results of scientific investigations in the field of organization of labour in construction and works out on this basis effective methods and forms of organization of labour processes;

f) carries out management of standard designing in construction, organizes the development and introduction of standard designs and designs of experimental construction, efficient and unified grading and structural solutions of industrial and public buildings, structures and apartment houses, works out the drawings of basic standard structural members and parts and extensively distributes them; approves and publishes with ministries and administrations lists (catalogues) of standard designs for utilization in construction; organizes the work of inter-branch and inter-type unification of construction projects;

*Translation supplied by the Division of Building Research, National Research Council of Canada.

g) performs in conformity with the plan of designing and surveying work: development of construction and special parts of design of the largest enterprises, buildings and structures, as well as design of projects being erected in foreign countries with the engineering participation of the Soviet Union according to a list approved by the GKES (Gosudarstvennyy Komitet Soveta Ministrov SSSR po vneshnim ekonomicheskim svyazyam; State Committee for Foreign Economic Relations of the Council of Ministers USSR) in agreement with Gosstroi USSR;

h) performs with the participation of interested ministries, administrations and public organizations open and closed competitions for designing buildings, structures and housing developments, designs of layout and building up cities, towns and rural populated places, general layout plans of industrial parks, economic industrial members and parts, efficient methods of construction, for better quality of building projects according to economic design, as well as competitions on other problems of designing and construction;

i) performs methodological management of work on expert control of designs and estimates for construction performed by ministries and administrations, as well as selective checking of the quality of designs approved by them; organizes expert checking of general layout plans of industrial parks; performs selective control of observations in the process of construction of the basic indices of designs approved by the Council of Ministers USSR;

j) together with the State Committee for Science and Technology of the Council of Ministers USSR with the participation of ministries and administrations USSR and councils of ministers of union republics;
– works out proposals about the basic principles of development of science and technology in the field of construction and architecture for the future, design of coordination plans for solving basic scientific and engineering problems and drafts of plans for training scientific cadres in the field of construction and architecture;
– determines the basic scientific and engineering problems in the field of construction and architecture;
– considers draft plans of scientific research work of ministries, and administrations USSR and union republics in the field of construction, architecture, construction materials and members, determines the volumes of financing the mentioned jobs for each ministry and administration USSR and union republic in the limits of the total allocations provided in the State Plan of Development of the National Economy USSR for scientific research jobs;
– carries out control of fulfillment of plans of scientific research work and introduction of the achievements of science and engineering into construction;

k) organizes scientific and engineering information in the field of construction and architecture, ensures the preparation and publication in the required manner of scientific and scientific-engineering literature, coordinates the activities or organs of scientific-engineering information in the field of construction, architecture, utilization of construction materials, members and articles and carries out methodological management of operation of these organs, considers submitted for coordination draft annual and future subject plans for publishing literature in the field of construction and architecture, as approved by the Committee on Publications of the Council of Ministers USSR;

l) organizes the development and introduction into construction of automated systems for planning and management, means of automation and mechanization of engineering and technical jobs on the basis of electronics and other methods of computer machinery;

m) works out together with ministries and administrations USSR and union republics proposals for increasing specialization and cooperation in construction, schemes for growth and distribution of enterprises of the construction industry in our country and approves them together with Gosplan USSR;

n) participates in the following:
– consideration of draft State Plans of Development of the National Economy USSR concerning capital construction, construction materials industry, construction and road machine-buildings and submits conclusions for the mentioned draft plans to the Council of Ministers USSR;
– development together with the State Committee for Science and Technology of the Council of Ministers USSR of draft plans of foreign business trips and international communications on problems of scientific-engineering cooperation and exchange of experience in the field of construction, architecture, output and utilization of construction materials;
– development of basic tendencies for creating new highly efficient machinery and mechanisms for construction;

o) performs management of operation of organs for construction control, performs checking of decrees of the government of the USSR on problems where Gosstroi is competent.

6. When carrying out functions connected with production-technical, financial and economic activities of subordinate organizations, establishments and enterprises, Gosstroi USSR follows the General Statutes about Ministries of the USSR.

7. Gosstroi USSR has the following rights:

a) enlist scientific workers, specialists, innovators of construction and production for development of separate problems of construction and architecture and for performing consultations and expert checking in this field;

b) perform in ministries and administrations, scientific research establishments, design and construction organizations and in enterprises producing construction materials, members and articles, checking of the technical level of construction design and construction, structural members and articles, as well as checking of plans of scientific research work, working out standardization documents for construction and architecture and state standards for construction materials, members and articles, sanitary engineering equipment and building tools, discuss reports and information on these problems, with heads of ministries and administration, and also by agreement with them – reports and information of managers of separate scientific research establishments, designing and construction organizations and enterprises and approve decisions on the basis of results of checking obligatory for the executors;

c) assign the solution of separate problems included in the field of action of Gosstroi USSR to Gosstrois of union republics, and the State Committee for Civil Construction and Architecture of Gosstroi USSR.

8. Gosstroi USSR is under the Chairman of the Committee designated in conformity with the Constitution of the USSR by the Supreme Soviet USSR, and in the period between sessions by the Presidium of the Supreme Soviet USSR with further introduction for approval by the Supreme Soviet USSR.

The Chairman of Gosstroi USSR has deputies designated by the Council of Ministers USSR. Distribution of duties between the deputy chairman is performed by the Chairman of Gosstroi USSR.

9. Gosstroi USSR in the limits of its competence publishes decisions and instructions and sends out directions obligatory for fulfillment by all ministries and administrations, as well as enterprises, organizations and establishments, independent of departmental subordination and checks their fulfillment.

10. Gosstroi USSR forms a Board consisting of the Chairman of the Committee (chairman of the board), deputy chairman according to their posts, as well as management workers in ministries, administrations and Gosstroi USSR.

The members of the Board of Gosstroi USSR are approved by the Council of Ministers USSR.

11. The Board of Gosstroi USSR at regular meetings discusses basic problems of technical policy in construction and architecture, designs of enterprises, buildings and structures to be approved by the Council of Ministers USSR, draft general layout plans of industrial parks and other problems in the competence of Gosstroi USSR, discusses problems of practical management of organizations, establishments and enterprises of the Committee, checking of performance, selection, distribution and training of cadres, drafts of the most important decisions, orders, instructions, norms and rules; listens to problems in the competence of the Committee, information of ministries and administrations, reports of gosstrois of union republics, State Committee for Civil Construction and Architecture of Gosstroi USSR, reports of main administrations, administrations and divisions, organizations, establishments and enterprises of Gosstroi USSR.

The decisions of the Board are performed, as a rule, on the basis of orders to the Chairman of Gosstroi USSR. In case of differences of opinion between the Chairman of the Committee and the Board, the chairman approves his own decision and informs the Council of Ministers USSR about the differences, while the members of the Board, in turn, may inform the Council of Ministers USSR about their opinion.

12. Gosstroi USSR, gosstrois of union republics, the State Committee for Civil Construction and Architecture of Gosstroi and their subordinate organizations, establishments and enterprises comprise the united system of Gosstroi USSR.

The gosstrois of union republics are subordinate to the councils of ministers of corresponding union republics and to Gosstroi USSR.

The Statutes about the gosstrois of union workers in the central staff are approved by the councils of ministers of union republics by agreement with Gosstroi USSR.

13. For considering the proposals for the basic principles and development of science and engineering in the field of construction and architecture, for working out proposals and recommendations for utilization and introduction into construction of the latest achievements of domestic and foreign science, engineering and foremost experience in Gosstroi USSR has been created a scientific-engineering council of foremost scientists, highly skilled specialists, innovators of production, as well as representatives of scientific-engineering societies and other organizations.

The members of the scientific-engineering council and regulations about the council are approved by the Chairman of Gosstroi USSR.

14. The structure and number of workers in the central staff of Gosstroi USSR are approved by the Council of Ministers USSR.

The staff schedule of the central staff of Gosstroi USSR is approved by the Chairman of Gosstroi USSR.

15. Gosstroi USSR has its own seal showing the State Seal of the USSR and the name of Gosstroi USSR.

Appendix 2

List of Organizations Represented on the Interdepartmental Commission on Problems of the North*

1. Scientific and Planning Organizations

Council for the Study of Resources and Development, State Planning Board, USSR (Belyi L. D., Granik G. I., Klopov, S. V., Letunov P. A., Lavin S. V. and others).

Council on Co-ordination, Academy of Sciences, USSR (Novikov V. D.).

The S. M. Kirov Kola Branch, Academy of Sciences USSR (Mazurov M. K., Freidin I. L.).

The Komi Branch, Academy of Sciences USSR (Vityazeva V. A.).

The Karelian Branch, Academy of Sciences USSR (Dadykin V. P.).

The Yakutian Branch, Academy of Sciences USSR (Mel'nikov V. G.).

The N. N. Miklukho-Maklai Institute of Ethnography, Academy of Sciences USSR (Levin M. G., Dolgikh B. O., Gurvich I. S.).

Institute of Geography, Academy of Sciences USSR (Dolgushin L. D., Dyakonov F. V., Kunitsin L. F.).

The V. L. Komarov Botanical Institute, Academy of Sciences USSR (Tikhomirov B. A.).

Zoological Institute, Academy of Sciences USSR (Portenko L. A.).

Permafrost Institute, Academy of Sciences USSR (Shumskii P. A.).

Institute of Oceanography, Academy of Sciences USSR (Ionin A. S.).

The Leningrad Department of the Institute of Ethnography, Academy of Sciences USSR (Vdovin I. S.).

The Northeastern Combined Research Institute of the Siberian Department, Academy of Sciences USSR (Yanovskii V. V.).

Institute of Vulcanology, Siberian Department, Academy of Sciences USSR (Dmitriev N. V.).

Arctic and Antarctic Research Institute, Ministry of the Mercantile Fleet USSR (Treshnikov A. F., Kopylkov V. N., Antonov V. S.).

All-Union Research Institute of Hydrogeology and Geological Engineering (Shvetsov P. F.).

Institute of Labour and Wages, Committee on Labour and Wages, Council of Ministers USSR (Shishkin N. I.).

Institute of Complex Transport Problems, State Planning Board USSR (Tsenin S. S.).

Central Economics Research Institute, State Planning Board RSFSR (Loginov V. P.).

Leningrad Branch, Academy of Construction and Architecture USSR (Murav'ev B. V.).

Research Institute for Arctic Geology (Ravich M. G., Lobanov M. F., Urvantsev N. N.).

Research Institute of Aeroclimatology (Klyukin N. K.).

Central Institute of Forecasting (Dmitrieva N. G.).

Institute of Nutrition, Academy of Medical Sciences USSR (Zaitsev A. I.).

*Problems of the North, No. 5, 1964.
Problemy Severa (5): 184-186, 1963.

Commission on Problems of Human Acclimatization in the North, Ministry of Health RSFSR (Danishevskii G. M.).

Research Institute of National Schools, Academy of Pedagogical Sciences RSFSR (Boitsova A. F.).

All-union Research Institute of Game and Resources (Ammosov V. A.).

Research Institute of Far Northern Agriculture (Andreev V. N.).

Research Institute on Building in Krasnoyarsk City (Krupitsa K. K.).

Republic State Planning Institute for the Planning of Agricultural Construction (Shevtsov A. M.).

State Institute for the Planning and Surveying of Highways (Bulis D. A.).

State Planning, Designing and Scientific Research Institute of Maritime Transport (Rodin E. D.).

State All-union Highways Research Institute (L'Vovich Yu. M.).

State Drafting and Surveying Institute (Mirgolovskii V. S.).

State Institute for the Technical and Economic Surveying and Planning of Railroad Transport (Savchenko F. T., Chertkov A. S.).

M. V. Lomonosov Moscow State University (Burkhanov V. F., Liverovskii Yu A., Uspenskii S. M., Mikhailov I. S.).

A. I. Gertsen Leningrad State Pedagogical Institute–Department of Far Northern Peoples (Belikov L. V., Matveev V. I.).

Moscow Institute of Highways (Korsak V. K.).

S. Ordzhonikidze Moscow Geological Prospecting Institute (Kuzakov K. G.).

Irkutsk Agricultural Institute (Sviridov N. S.).

2. Ministries, Departments, Planning Organizations, Executive Committees of Councils of Workers' Deputies and other Organizations.

Department of Soviet Bodies of the Council of Ministers RSFSR (Drozdov B. T.).

State Planning Board RSFSR (Denisov B. D., Khristenko V. N.).

Planning and Economic Board of the Ministry of Communications USSR (Golubev G. S.).

Ministry of Production and Procurement of Agricultural Products RSFSR (Zhigunov P. S.).

Ministry of Education RSFSR (Kuzakova E. A.).

Ministry of Culture RSFSR (Kudryakov V. N.).

Ministry of Agriculture RSFSR (Shapiro I. V.).

Chief Administration of Health Services, Ministry of Health RSFSR (Zhitinskaya N. A.).

Chief Administration of the Civil Air Fleet USSR (Shevelev M. I.).

Chief Administration of the Northern Sea Route, Ministry of the Mercantile Fleet USSR (Tolstikov E. I., Levin I. G.).

Appendix 3

Decree of the USSR Supreme Soviet Presidium

On Extension of Privileges for Persons Working in the Areas of the Far North and Localities Equated to Regions of the Far North

In amendment of and addition to the Decree of the USSR Supreme Soviet Presidium on February 10, 1960, "On Regulating Privileges for Persons Working in the Areas of the Far North and in Localities Equated to Regions of the Far North," the Presidium of the USSR Supreme Soviet RESOLVES:

1. To pay all factory and office workers employed at state, cooperative and public enterprises, institutions and organisations the following additions to their monthly earnings (not taking into consideration the district wage-rate and long-service increment):

a) In the Chukotsk National Area and the North-Evensk District of Magadan Region, the Koryak National Area and the Aleutsk District of Kamchatka Region, and also on the islands in the Arctic Ocean and its seas (with the exception of the White Sea islands) –10 per cent on the expiration of the first six months of work, with a subsequent increase of 10 per cent for every six months of work. To bring up the maximum sum of the additions in the above-mentioned districts and localities to 100 per cent of the earnings or to 300 roubles a month.

b) In the remaining districts of the Far North–10 per cent on the expiration of the first six months of work, with a subsequent increase of 10 per cent for every six months of work, but on reaching 60 per cent–10 per cent for each subsequent year of work.

c) In localities considered equivalent to the areas of the Far North–10 per cent on the expiration of the first year of work, with an increase of 10 per cent for each subsequent year of work.

To establish that the additions to earnings received by factory and office workers as of January 1, 1968, in percentages of their monthly earnings, are not recalculated. Subsequent additions are to be calculated in keeping with this clause.

2. Factory and office workers who have been employed in the areas of the Far North for not less than 15 calendar years, and in localities considered equivalent to the areas of the Far North–for not less than 20 calendar years, become eligible for old-age pensions as follows: men at the age of 55, and women at the age of 50 years.

3. To reduce the period of the labour contract granting the right to privileges envisaged by Clause 5 of the Decree of the USSR Supreme Soviet Presidium of February 10, 1960, "On Regulating Privileges for Persons Working in the Areas of the Far North and in Localities Considered Equivalent to the Areas of the Far North," from five to three years.

To extend the given privileges to persons coming to these areas and localities on their own initiative, provided that they have signed labour contracts for a period of three years, and on the islands in the Arctic Ocean–for two years.

To double the allowance granted to young specialists sent to work in the areas of the Far North and in localities considered equivalent to the areas of the Far North from other districts of the country, on finishing higher and specialised secondary education.

4. To pay workers who renew their contract for a second period of work in the areas of the Far North and in localities equivalent to the areas of the Far North an extraordinary allowance in the sum of 50 per cent of their average monthly earnings, not taking into consideration the zonal wage-rate, long-service increment and additional pay for work in the areas of the Far North and in localities considered equivalent to the areas of the Far North.

5. To sum up a continuous service record, granting the right to the privileges envisaged in this Decree, for members of families of factory and office workers employed in the areas of the Far North and in localities considered equivalent to the areas of the Far North, who are engaged for seasonal work in these areas and localities, and for women who temporarily left work in order to look after children of pre-school age or in connection with the state of their health.

6. To include the period of work on collective farms in the areas of the Far North and in localities considered equivalent to the areas of the Far North in the length of service granting the right to the privileges envisaged in this Decree, for specialists, persons holding elective offices and other managing personnel of collective farms, provided that not more than three months elapsed between the moment of leaving the collective farm and the time of employment as a factory or office worker (travelling time to the new place of work excluded).

7. To instruct the Council of Ministers of the USSR to adopt a decision on the implementation of this Decree and to amend correspondingly the decisions of the Soviet Government.

8. This Decree is to come into effect as from January 1, 1968.

9. To submit this Decree for approval to the USSR Supreme Soviet.

N. Podgorny, President of the Presidium of the USSR Supreme Soviet.

M. Georgadze, Secretary of the Presidium of the USSR Supreme Soviet.

September 26, 1967

The Kremlin, Moscow

Appendix 4

Comparison of the Soviet Decrees on Privileges for Northern Workers*

Incentives granted to persons working in the 'Far North' were first applied by a decree in 1932 and included such items as an increase in basic pay through the use of a northern increment, increased pension rights, and certain privileges in education and housing. Generally speaking, this policy has been adhered to in broad outline ever since with the subsequent decrees of 1 August 1945, 10 February 1960, and finally the proposed new decree of 1 January 1968.

In comparing the decrees of 1945, 1960, and 1968, it is interesting to note that some incentives granted by the new decree, such as the increase in the northern increment from 80 per cent to 100 per cent in certain areas, the rate of increment at 10 per cent every six months, and others, were incentives which were actually established in 1945, and then withdrawn in 1960. In 1960, apart from certain Arctic regions, the workers' annual pay increase was reduced by 5 per cent which naturally caused much dissatisfaction. According to Slavin (a GOSPLAN member and leading Soviet northern specialist), the sharp increase in the turnover of labour in the northern regions was a direct result of this drop in northern increment.

1) The zones established by the 1960 decree to differentiate between the various rates of benefit are enlarged for the 1968 decree and are designated as two divisions of "The Far North", zone (1) and zone (2) and 'Regions equated to the Far North', zone (3). See Map #5.

2) The permitted maximum northern increment was lowered from 100 per cent (1945) to 80 per cent (1960) and then raised to 100 per cent (1968) with a maximum of only 300 roubles a month in zone (1). In zone (2) the maximum northern increment remained at 80 per cent not exceeding 240 roubles a month. In zone (3) the figures were 50 percent and 150 roubles a month.

3) Increasing the rate at which the maximum northern increment was reached in all zones, and raising the permitted maximum in zone 1 was no doubt a reply to Soviet critics who argued that lowering the northern increment in 1960 was a prime cause for the large turnover of labour in the Soviet North.

4) The reduction in length of labour contracts from 5 years to 3 years was made because the longer period certainly tended to frighten workers away. The 1945 decree had stipulated labour contracts of three years but the 1960 decree had lengthened this to 5 years. The granting of privileges to persons coming to the north on their own initiative and then signing a work contract was first applied in 1960 and then extended to include the payment of travelling expenses in 1968.

5) With respect to old-age pensions a significant change was made by the 1968 decree. Although one year of northern service had counted for two for pension entitlement in 1945 (reduced to one and a half in 1960), this really meant very little since the pension was granted to all workers on a universal age basis. However, the change introduced by the 1968 decree takes into account that severe climatic conditions affect people just as adversely as difficult and harmful working conditions, and makes men at 55 and women at 50 eligible for old-age pensions if they have been employed in zones (1) and (2) for 15 years or zone (3) for 20 years.

6) Other benefits, such as giving young graduating specialists a grant for coming to work in the north, and extending certain privileges to members of families who are engaged in seasonal work, were also included in this decree.

These were the major benefits offered by the new decree but in addition, there is another wage adjustment granted northern workers, which is applicable to all remote regions in the Soviet Union, and not just the north. This is called a "regional bonus" or a "regional coefficient" which is in essence a cost-of-living allowance. See Map #6.

*For a detailed account see the following Articles in *The Polar Record*. Terence Armstrong "Labour in Northern USSR" Vol. 13, No. 87, 1967, pp. 769-74. "Labour in Northern USSR" Vol. 14, No. 89, 1968. pp. 215-30.

Appendix 5

Growth of the Major Siberian & European Far North Cities 1939 - 1969 (in thousands)*

		Lat. ° ′		Long. ° ′		1939†	1959	1962	1965	1966	1968	1969	Pop. incr. since 1959	% incr. since 1959
European Far North														
Archangel (Arkhangel'sk)	1‡	64	32N	40	40E	251	256	276	303	308	313	318	62	24.2
Kotlas	1	61	15N	46	35E	17	39	–	59	60	61	61	22	56.4
Monchegorsk	2	67	55N	33	01E	28	46	–	54	53	53	53	7	15.2
Murmansk	2	68	59N	33	08E	119	222	245	272	279	296	307	85	38.2
Petrozavodsk	3	61	46N	34	19E	70	136	142	157	164	175	181	45	33.0
Severodvinsk	1	64	35N	39	50E	21	79	97	113	117	124	129	50	63.2
Syktyvkar	4	61	42N	50	45E	24	64	79	94	98	106	132	68	10.6
Vorkuta	4	67	27N	64	00E	–	56	60	63	64	65	65	9	16.0
Eastern Urals (Western Boundary of Siberia)														
Asbest	5	57	05N	61	30E	29	60	–	74	76	75	76	16	26.6
Chelyabinsk	6	55	12N	61	25E	273	680	751	805	820	851	871	182	26.4
Kamensk-Ural'skiy	5	56	29N	61	49E	51	141	152	158	159	163	165	24	17.0
Kopeisk	6	55	08N	61	39E	60	161	–	168	167	165	166	5	3.1
Korkino	6	54	55N	61	25E	12	85	–	88	84	83	79	–6	–7.0
Krasnotur'insk	5	59	46N	60	10E	10	62	–	62	62	61	61	–1	–1.6
Magnitogorsk	6	53	28N	59	06E	146	311	333	348	352	360	364	53	17.0
Miass	6	55	00N	60	00E	38	99	109	117	119	124	127	28	28.2
Nizhnii Tagil	5	58	00N	59	58E	160	339	359	370	375	379	383	44	12.9
Serov	5	59	42N	60	32E	65	98	102	104	105	104	104	6	6.1
Sverdlovsk	5	56	52N	60	35E	423	779	853	919	940	981	1,001	222	28.4
Troitsk	6	54	08N	61	33E	47	76	–	84	85	87	87	11	14.4
Zlatoust	6	55	10N	59	38E	99	161	167	175	176	180	181	20	12.4

*Note: Population figures for the years 1961, 1965, 1966, 1967 and 1968 are all taken from *National Economy of the USSR.*

†For 1939 and 1959 figures are taken from the official census: for 1962, 1965, 1966, 1968 and 1969 they are from official estimates. A blank entry may be the result of the following:

a) the population was less than 50,000,
b) information unavailable,
c) city did not exist.

‡The numbers given after the names of towns show the region in which the town is located. The names of the regions are listed at the end of this table.

**Located in the northern part of Kazakhstan.

		Lat. ° ′		Long. ° ′		1939	1959	1962	1965	1966	1968	1969	Pop. incr. since 1959	% incr. since 1959
Western Siberia														
Abakan	7	53	43N	91	25E	37	56	–	71	74	80	83	27	48.2
Achinsk	7	56	20N	90	33E	32	50	–	64	66	76	85	35	70.0
Anzhero-Sudzhensk	8	56	10N	86	01E	69	116	120	119	118	115	114	–2	–1.7
Barnaul	9	53	21N	83	15E	148	305	347	382	395	418	429	124	40.6
Belovo	8	54	27N	86	19E	43	107	118	114	115	116	116	9	8.4
Biisk	9	52	35N	85	16E	80	146	165	175	176	184	188	42	28.7
Chernogorsk	7	53	48N	91	16E	17	51	–	58	59	63	63	12	23.5
Gorno-Altaisk	16	51	57N	85	58E	24	28	–	31	31	32	34	6	21.4
Kemerovo	8	55	25N	86	05E	133	278	305	351	358	372	380	102	36.6
Kiselevsk	8	54	01N	86	41E	44	130	142	140	139	137	135	5	3.8
Kurgan	10	55	30N	65	20E	53	146	173	198	205	222	229	83	56.8
Leninsk-Kuznetskii	8	54	44N	86	13E	83	132	140	141	140	137	135	3	2.2
Mezhdurechensk	8	53	43N	88	11E	–	55	–	74	77	80	81	26	47.2
Novokuznetsk	8	53	45N	87	12E	166	377	410	475	484	495	500	123	32.6
Novosibirsk	11	55	04N	83	05E	404	886	985	1,029	1,049	1,079	1,098	212	23.9
Omsk	12	55	00N	73	22E	289	581	650	721	746	800	826	245	42.1
Osinniki	8	53	39N	87	22E	25	68	–	71	70	68	67	–1	–1.4
Petropavlovsk**	15	54	53N	69	13E	92	131	–	158	162	170	174	43	32.8
Prokop'evsk	8	53	55N	86	45E	107	282	292	291	291	286	283	1	.3
Rubtsovsk	9	51	34N	81	11E	38	111	127	136	140	143	145	34	30.6
Tavda	5	58	04N	65	12E	25	48	–	50	–	–	–	–48	0
Tomsk	13	56	30N	85	05E	145	249	275	302	311	334	343	94	37.7
Tyumen	14	57	11N	65	29E	79	150	174	201	218	256	271	121	80.6
Shadrinsk	10	56	08N	63	32E	31	52	–	64	64	67	69	17	32.6
Yurga	8	55	43N	84	52E	–	47	–	54	54	55	56	9	19.1

		Lat.		Long.									Pop. incr. since 1959	% incr. since 1959
		°	′	°	′	1939	1959	1962	1965	1966	1968	1969		
Eastern Siberia														
Angarsk	17	52	31N	103	55E	–	134	160	176	179	187	190	56	41.7
Bratsk	17	56	20N	101	50E	–	51	–	107	113	129	134	83	16.2
Cheremkhovo	17	53	08N	103	01E	56	123	–	113	111	107	104	–19	–15.4
Chita	22	52	03N	113	35E	121	172	185	198	201	208	214	42	24.4
Irkutsk	17	52	18N	104	15E	250	366	385	401	409	428	435	69	18.8
Kansk	7	56	11N	95	48E	42	74	–	92	91	90	90	16	21.6
Krasnoiarsk	7	56	05N	92	46E	190	412	465	541	557	592	603	191	46.3
Kyzyl	18	51	45N	94	28E	10	34	–	44	45	48	49	15	44.1
Magadan	19	59	38N	150	50E	27	62	–	79	81	85	88	26	41.9
Noril'sk	7	69	21N	88	02E	14	109	117	124	127	127	133	24	22.0
Ulan-Ude	20	51	55N	107	40E	126	175	196	213	220	235	244	69	39.4
Usol'e-Sibirskoe	17	52	48N	103	40E	20	48	–	69	73	78	81	33	68.7
Yakutsk	21	62	10N	129	50E	53	74	–	89	92	98	104	30	40.5
Far East														
Artem	23	43	23N	132	08E	35	56	–	64	65	65	65	9	16.0
Belogorsk	24	50	55N	128	26E	34	49	–	50	50	52	53	4	8.1
Birobidzhan	25	48	49N	132	54E	30	41	–	43	44	47	50	9	21.9
Blagoveschensk	24	50	19N	127	30E	59	95	101	114	118	125	130	35	36.8
Khabarovsk	25	48	32N	135	08E	207	323	363	408	420	448	466	143	44.2
Komsomol'sk-na-Amure	25	50	32N	136	59E	71	177	192	204	207	210	216	39	22.0
Nakhodka	23	42	53N	132	54E	–	64	–	89	92	100	104	40	62.5
Petropavlovsk-Kamchatskii	26	53	03N	158	43E	35	86	100	115	119	129	148	62	72.0
Svobodnyi	24	51	24N	128	05E	44	57	–	61	61	62	64	7	12.2
Ussuriisk	23	43	48N	131	59E	72	104	113	121	123	124	127	23	22.1
Vladivostok	23	43	09N	131	53E	206	291	325	367	379	410	424	133	45.7
Yuzhno-Sakhalinsk	27	46	58N	142	45E	–	86	86	90	91	93	96	10	11.6

1 Arkhangel'skaya Oblast'
2 Murmanskaya Oblast'
3 Karel'skaya ASSR
4 Komi ASSR
5 Sverdlovskaya Oblast'
6 Chelyabinskaya Oblast'
7 Krasnoyarskiy Kray
8 Kemerovskaya Oblast'
9 Altayskiy Kray
10 Kurganskaya Oblast'
11 Novosibirskaya Oblast'
12 Omskaya Oblast'
13 Tomskaya Oblast'
14 Tyumenskaya Oblast'
15 Severo-Khazakhstanskaya Oblast'
16 Gorno-Altayskaya Oblast'
17 Irkutskaya Oblast'
18 Tuvinskaya ASSR
19 Magadanskaya Oblast'
20 Buryatskaya ASSR
21 Yakutskaya ASSR
22 Chitinskaya Oblast'
23 Primorskiy Kray
24 Amurskaya Oblast'
25 Khabarovsk Kray
26 Kamchatskaya Oblast'
27 Sakhalinskaya Oblast'

Appendix 6

Meeting with Gosstroi

I am particularly pleased to be the first Canadian Minister to visit your country following the signing of the Canada-Soviet Protocol on Consultations by my Prime Minister and the Chairman of the Council of Ministers of the USSR. I am very happy to be here today and I am certain that the next sixteen days will be the most interesting and perhaps the most useful that I have yet experienced as Minister of Indian Affairs and Northern Development.

My Department has always had the most cordial relations with your organization ever since the first visit made by my predecessor the Honourable Arthur Laing to your country in 1965 and the return visit made by Deputy Chairman Slivinsky and later by Deputy Chairman Ganichev to Canada. As you are aware I am most interested in pursuing the policy of expanding northern exchanges with your country. I feel the two areas in which the maximum benefit would result between Gosstroi and my Department are:

(1) exchange of information on design, construction and operation of buildings and other structures on permafrost;
(2) development and disposition of a northern industrial and transportation network.

In the area of construction my Department is primarily concerned with the actual construction in the north. That is to say, with the actual problems of getting the job done on the ground and not with research. I know from my own experience that the main principles of planning and provision of utilities in apartments and houses in the Arctic as they appear on drawing boards in Ottawa have to be modified and changed, at times even drastically, in the actual construction in the far north. I will, therefore, be most interested in travelling throughout your north, and witnessing the success you have had in your applied northern construction techniques.

That you have experience in the development of your far north is undoubtedly the result of your being able to overcome or at least cope with the problems of construction that had occurred in these areas. I am certain that we can learn from your experience in such broad areas as the planning and the architecture of towns in the far north, construction on permafrost, water supply, sewerage and heating.

I would like to say that exchanges of delegations and access to each others experiences in northern socio-economic development as well as in scientific and technological research, will assist in the development of better and more fruitful relations between our two countries. In addition, I feel very strongly that my visit to your country is an extension of the better understanding that has evolved between both our countries since the signing of the Canada/U.S.S.R. Agreement on the industrial application of science and technology, by the Honourable Mr. Pepin and the most recent visit by my Prime Minister to your country.

Appendix 7

Arkticheski i Antarkticheski nauchno-issledovatelski institut, AANII (Arctic and Antarctic Research Institute), Leningrad.*

The Commission for Study of the North (Komissia po izucheniu Severa) was set up in 1919; it was followed by the establishment of the Northern Scientific and Commercial Expedition (Severnaia nauchno-promyslovaia ekspeditsiia) on March 4, 1920, commonly considered the foundation date of the Arctic Institute. The Institute for Study of the North (Institut po izucheniu Severa) was organized in 1925, renamed All-Union Arctic Institute (Vsesoiuzny arkticheski institut) in 1930, and placed under the jurisdiction of the Main Administration of the Northern Sea Route No. 1, as Vsesoiuzny arkitcheski institut Glavsevmorputi, in 1933. In 1939, it became the Arctic Research Institute of the Main Administration of the Northern Sea Route (Arkticheski nauchno-issledovatelski institut Glavsevmorputi) and assumed its present name in 1958.

Its directors since 1930: 1930-33, Otto IUl'evich Shmidt; 1933-38, Rudol'f Lazarevich Samoilovich; 1938-Viktor Kharlampovich Buinitski?. Petr Petrovich Shirshov; in 1950, V. S. Antonov; 1950-60, Viacheslav Vasil evich Frolov, d. Aug. 22, 1960; 1960- , Aleksei Fedorovich Treshnikov. Deputy directors: 1956, A. F. Treshnikov, M. E. Ostrekin, V. M. Pasetski, A. P. Kabalin, M. M. Somov, A. I. Mineev; in 1958, N. A. Volkov; in 1961, P. A. Gordienko.

Departments, sections, etc., known prior to 1956: Economic biology section (Promyslovo-biologicheskii sektor) founded in 1931, with K. M. Derinugin as head; dept. of Reindeer husbandry with a division of animal technology and veterinary science (Otdel olenevodstva s razdelom zootekhnia i veterinaria); Hydrographic section; Hydrological dept.; Geological dept. absorbed in 1940 by the Mining and Geology Administration of Glavsevmorput', re-established in 1945, reorganized about 1946, and set up separately as the Research Institute of Geology of the Arctic No. 4; Geophysics dept. with section of: aerology, actinometry, terrestrial magnetism and electricity; dept. of Cartography and geodesy organized in 1932; Geographical dept.; dept. of Meteorology and weather forecasting; dept. of Polar stations headed from 1942 to about 1946 by L. I. Leonov; dept. of Expeditions headed in 1946-52 by L. I. Leonov; dept of High Latitudes expeditions (Otdel vysokoshirotnykh ekspeditsi); dept. of Oceanography; dept. of Economics; bureau of Ice engineering (Ledotekhnicheskoe biuro) founded in 1935; laboratory of Soil granulometry (Laboratoria granulometri gruntov); bureau of Bibliography founded in 1933; Photographic laboratory and photo archives transferred to Glavsevmorput in 1935; Ice research and Ice forecasting depts. (Otdel ledovykh issledovani, Otdel ledovyh prognozov), both known to have existed in 1945; and the Kamchatka Branch of the All-Union Arctic Institute (Kamchatskoe otdelenie Vsesoiuznogo arkitcheskogo instituta, KOVAI) founded in 1932, now closed.

Departments, sections, etc. mentioned in 1956; Moscow Branch of the Arctic Institute (Moskovskoe otdelenie Arkticheskogo instituta, MosANII) headed by A. I. Mineev; dept. of Meteorology and weather forecasting (Otdel meteorologi i prognozov pogody) headed by A. A. Girs and its Climatology section (Sektor klimatologi), now known as dept. of Climate (Otdel Klimata) headed by I. M. Dolgin; dept. of Oceanography, ice forecasting and river mouths (Otdel okeanografi, ledovykh prognozov i ust ev rek) headed by A. F. Laktionov: its Ice forecasting section headed by A. A. Kirillov and River mouths section by V. S. Antonov; Geophysics dept. headed by A. P. Nikolski; Geographical dept. headed by I. A. Gakkel; its History section headed by M. I. Belov and Geomorphology section by G. V. Gorbatski; low temperature laboratory under I. S. Peschanski; bureau of Instrument construction (Konstruktorskoe biuro) headed by B. V. Felisov, with a laboratory of New techniques (Laboratoria novoi tekhniki); Hydrochemical laboratory; equipment store and workshops under Riabov; a library with 88,000 volumes in 1956, headed by Bogdanov; archives, with over 3000 reports on expeditions.

Departments, etc. cited in recent literature: Learned council (Ucheny Sovet); dept. of the History of the North (Otdel istori Severa) founded in 1941, possibly its former History section; dept. of River estuaries (Otdel ustevykh uchastkov rek); Ice research laboratory (Ledoissledovatel skaia laboratoria), probably the former Ice research dept. headed by I. S. Peschanski in 1957; laboratory for Ice research and testing models of icebreakers and ice-strengthened ships (Laboratoria dlia issledovania l da i ispytania modelei ledokolov i sudov ledovogo klassa); Ship construction research laboratory (Korableissledovatel skaia laboratoria) founded in 1946 as dept. for Ship construction research, reorganized as laboratory in 1951, and headed by A. A. Yakovlev in 1957; Lake Ladoga methodological station (Ladozhskaia metodicheskaia stantsia).

Nearly 300 expeditions were sent out by the Arctic Institute during 1920-45, some hundred of them geological parties, over 120 expeditions during 1951-56; and since then, an average of five large expeditions and twenty field parties a year. Its budget amounted to 30 million rubles in 1956.

*Reprinted from Vladas Stanka, *Institutions of the USSR Active In Arctic Research and Development*, (Washington: Arctic Institute of North America, 1963), pp. 5-7.

Publications: Trudy, v. 1-243, 1920-61. Besides the widely known series, there is another series of Trudy, evidently classified or restricted in distribution; of which v. 2, 10, 19, and 20 were published in 1949; v. 33, 36, 45 in 1951; v. 32, 34 in 1952; v. 54 in 1953; v. 76, 80, 88 in 1955; v. 81, 83, 84 in 1956. Other publications are: Materialy po izucheniu Arktiki (Materials for study of the Arctic), no. 1-8, 1931-35; Arctica, kniga 1-5, 1933-36; Sovetskoe olenevodstvo (Soviet reindeer husbandry), 1936-37; Sovetskaia Arktika, 1935-41; Biulleten' Vsesoiuznogo arkticheskogo institua, 1931-37; Posobia i rukovodstva (Manuals and guides), 1944-53; Problemy Arktiki (Since 1959; Problemy Arktiki i Antarktiki), 1937-62, with interruptions; Informatsionny biulleten Sovetskoi antarkticheskoi ekspeditsi, 1957-60. Biulleten inosrannoi nauchno-tekhnicheskoi informatsi, 1957, no. 2(43).

Appendix 8
Selected Schematic Diagrams of Water Utilities, Sewers and Heating Networks for towns in Permafrost Regions.*

The following diagrams illustrate the basic designs of water utilities, sewers and heating pipes for the cities of Yakutsk, Mirny and Norilsk:

Reproduced from Handbook of Water Utilities, Sewers, and Heating Networks designed for Settlements In Permafrost Regions. (Northern Science Research Group: Indian Affairs and Northern Development; 1970). Numbers in brackets indicate the page number of the original text

Figure 1
Branching of water and sewer lines in Crawl Spaces and accessible Conduits (Norilsk)

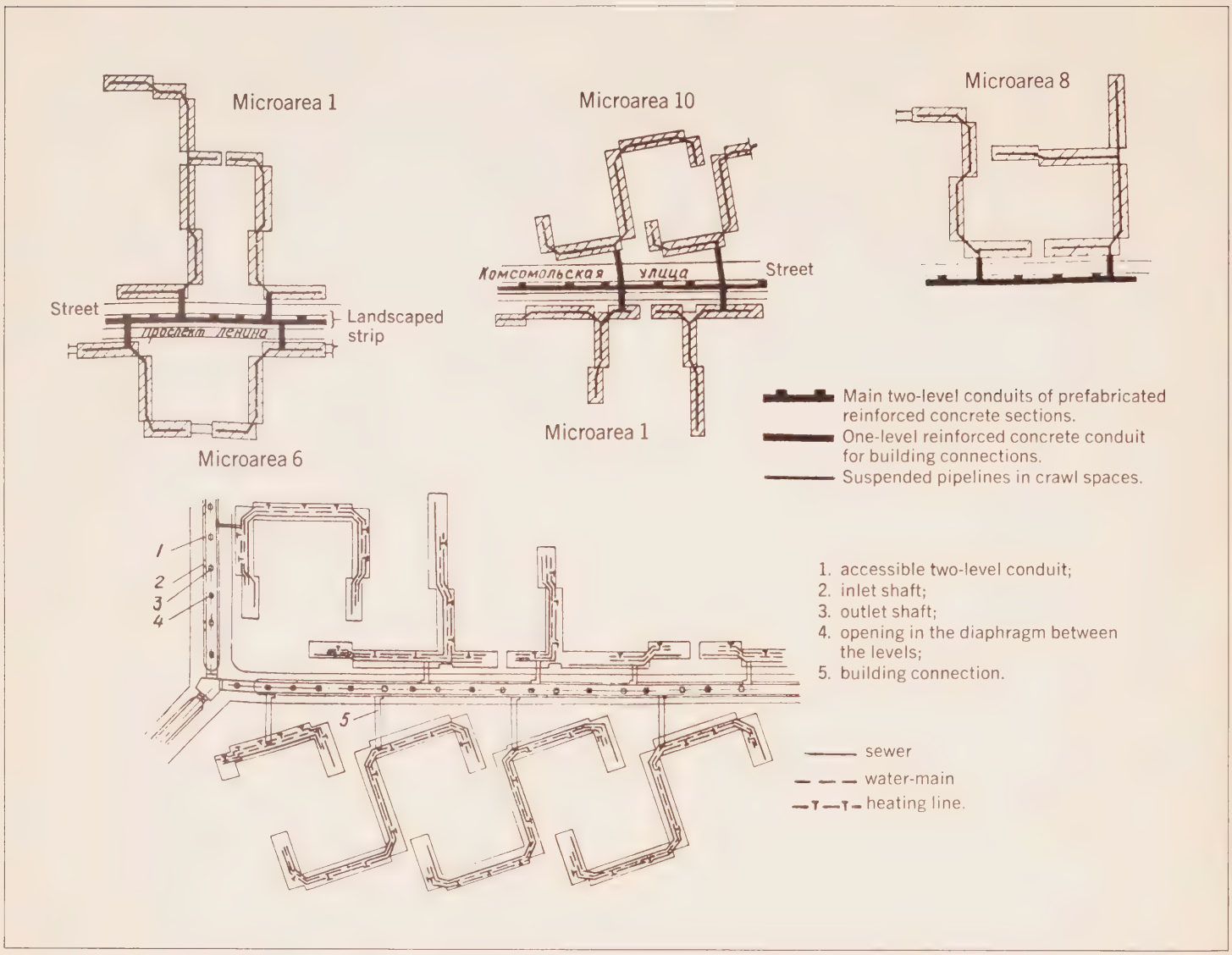
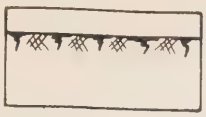
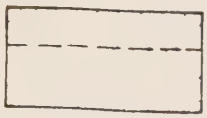


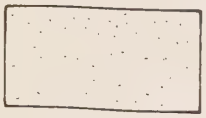
Figure 2
Symbols used



1. ground surface



2. permafrost table



3. local soil

4. sandy soil with gravel

5. special back fill

6. clay-gravel mixture

7. rock

8. crushed rock

9) B. water-mains

K. sewers

T. heating line

10) Composition of clay-gravel

gravel and pebbles	40%
coarse-grained sand	25%
fine-grained sand	15%
clay	20%
water	200 kg/m²

Figure 3
Support for a Suspended Pipeline (Norilsk)

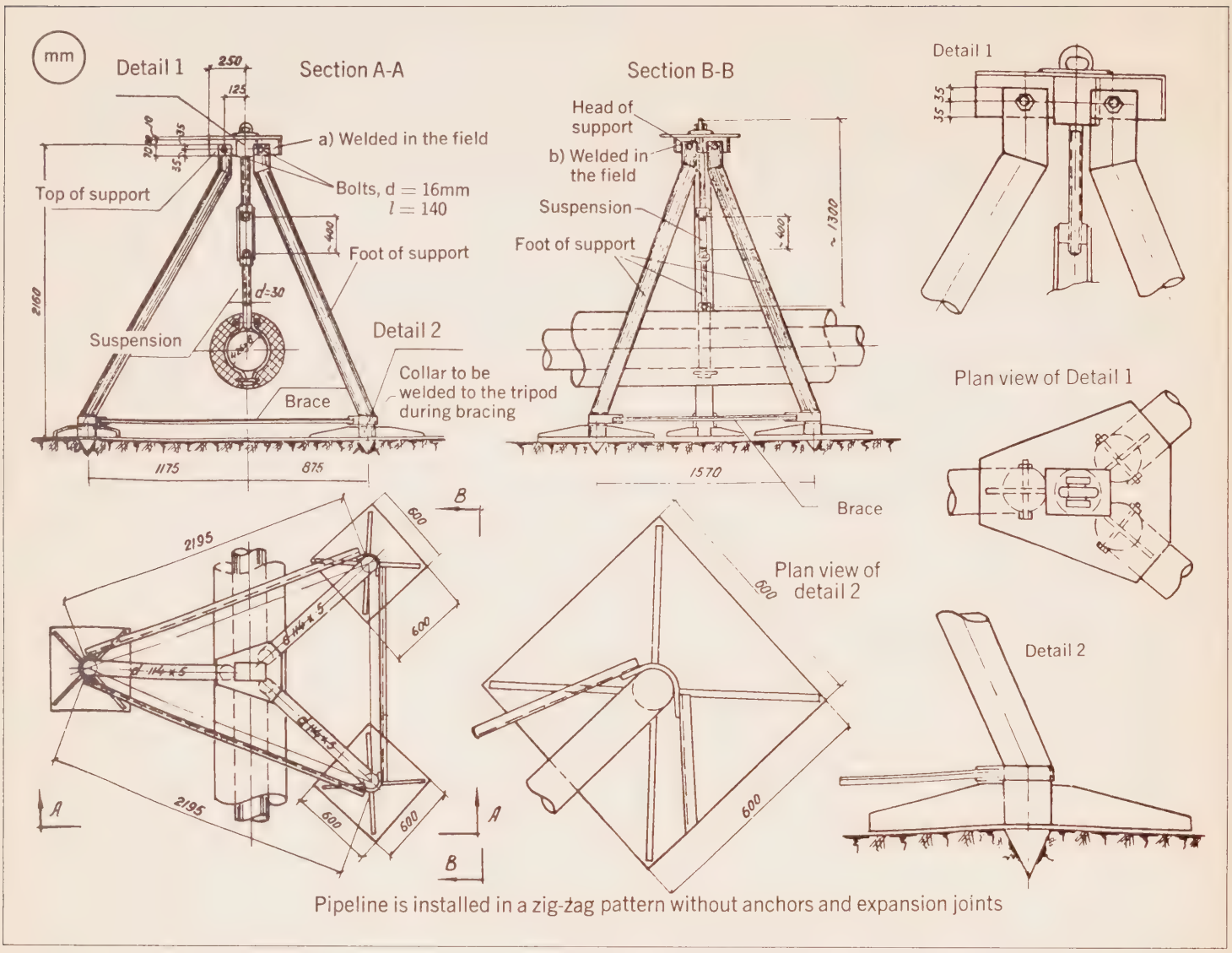
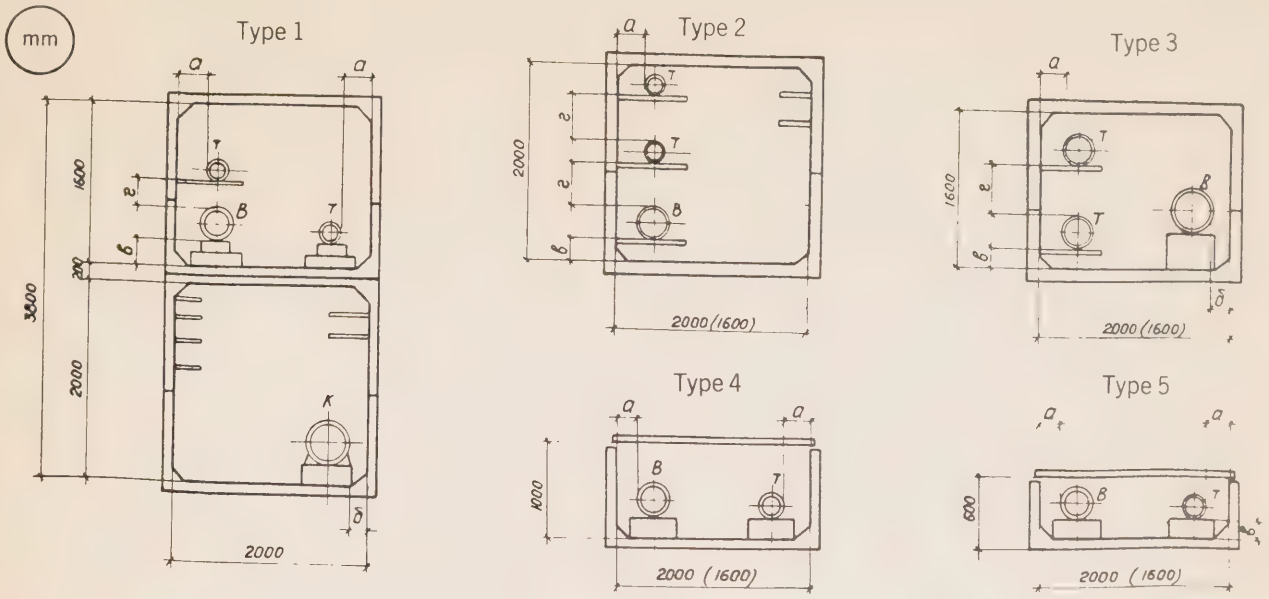


Figure 4
Prefabricated reinforced concrete conduits and location of pipelines (Norilsk)

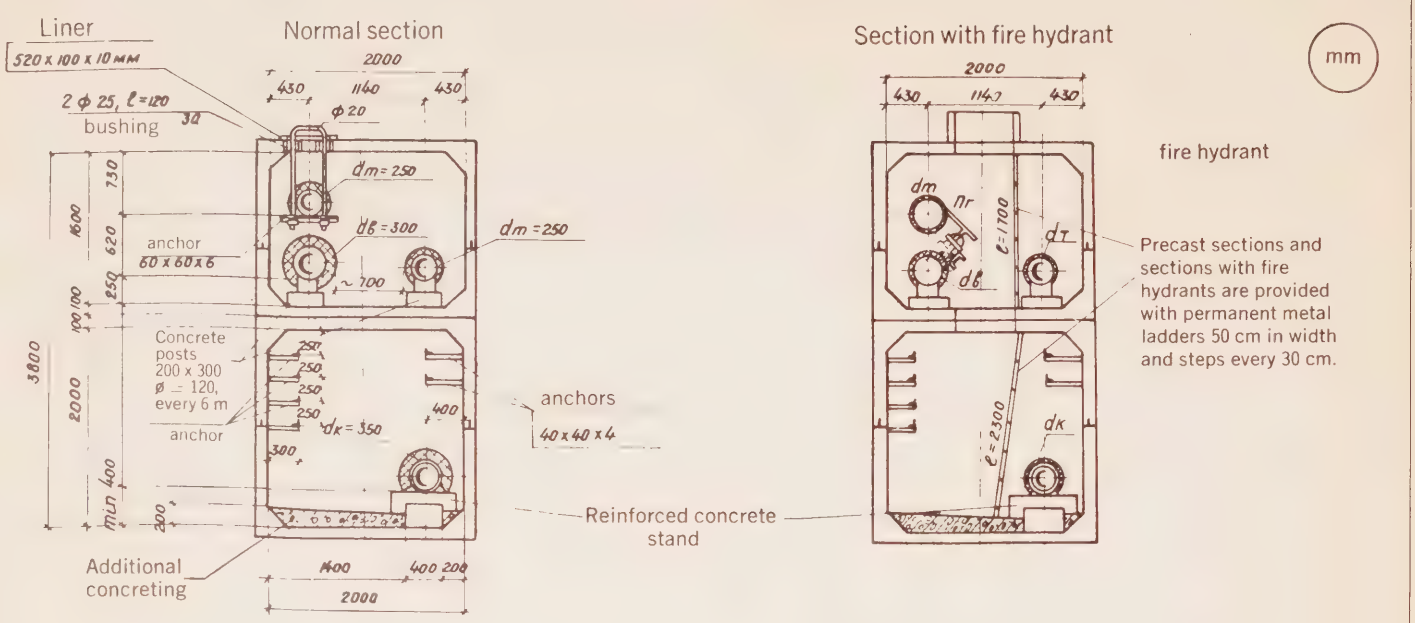


a. distance from the surface of pipe to the wall of conduit:
160 mm — at ø up to 150 mm;
270 mm — at ø from 200 to 300 mm;
400 mm — at ø over 300 mm;
b. distance from the surface of sewer pipe to the wall of conduit:
200 mm — at ø from 150 to 350 mm;
300 mm — at ø over 350 mm;
c. distance from the floor of conduit to the pipe wall:
250 mm — at ø from 100 to 400 mm;
300 mm — at ø from 450 to 600 mm;
B — watermain, K — sewer pipe;
T — heating pipe
d. vertical distance between pipe walls:
250 mm — at ø from 100 to 200 mm;
300 mm — at ø from 250 to 350 mm;
350 mm — at ø from 400 to 500 mm.

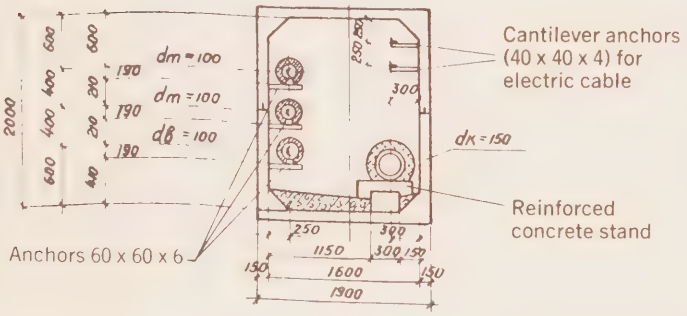
Volume of reinforced concrete per linear meter of conduit

Type of conduit	clear cross-sectional area		Volume of concrete, m^3	Remarks
	width mm	height mm		
1	2000	3800	1,782	Upper level 1.6m Lower level 2m
2	2000	2000	0,934	
	1600		0,746	
3	2000	1600	0,850	
	1600		0,670	
4	2000	1000	0,778	Including removable cover of beams measuring 120 x 150 mm
	1600		0,629	
5	2000	600	0,697	
	1600		0,564	

Figure 5
Two-level reinforced concrete conduit
(Norilsk)



House connections in single level conduits



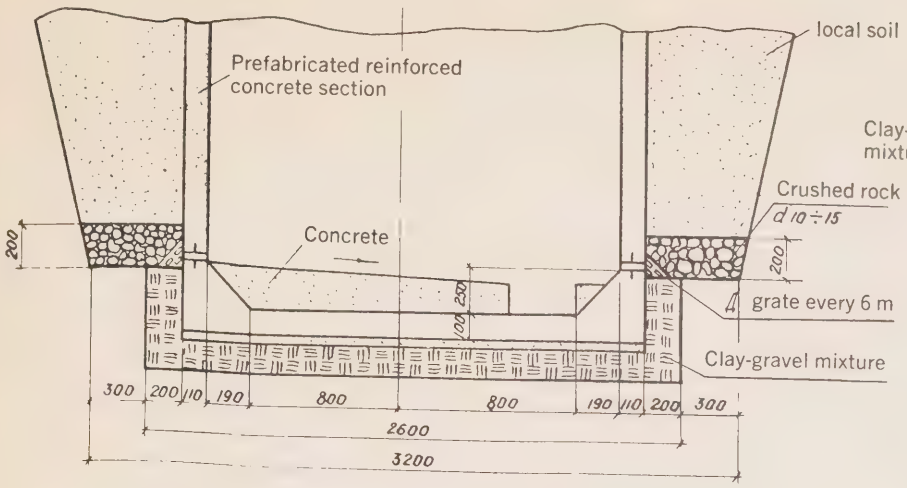
Volume of work per linear m of conduit (in cu. m)

No	Item	Volume per linear m of conduit	Volume per linear m of house connection
1.	Reinforced concrete	1.782	0,746
2	Excavation	19.58	7,07
3	Special backfill	1,88	1,76
4	Placement of clay-gravel mixture	0,63	0,6
5	Additional concreting	0,24	0,24
6	Backfill	12,73	2,79

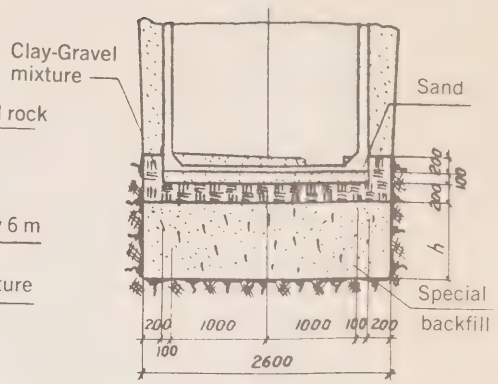
Figure 6
Drainage and foundations of conduits
(Norilsk)

mm

Foundation drainage



Foundation on soils subject to settlement



Drainage may be in the form of pipes. The pipe is closed with a metal grate and covered with a layer of filtering material.

Water in the trough on the bottom of the conduit runs off down the slope of the conduit.

Foundation soils which settle by more than 5 cm per linear meter of depth are replaced by soil, not subject to settlement, to a depth of 0.8 m (depth of thawing below the conduit).

Foundations on soils not subject to settlement

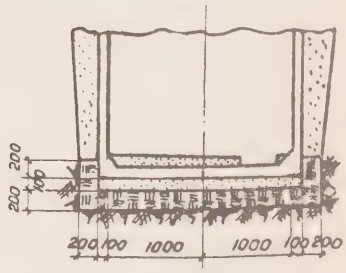
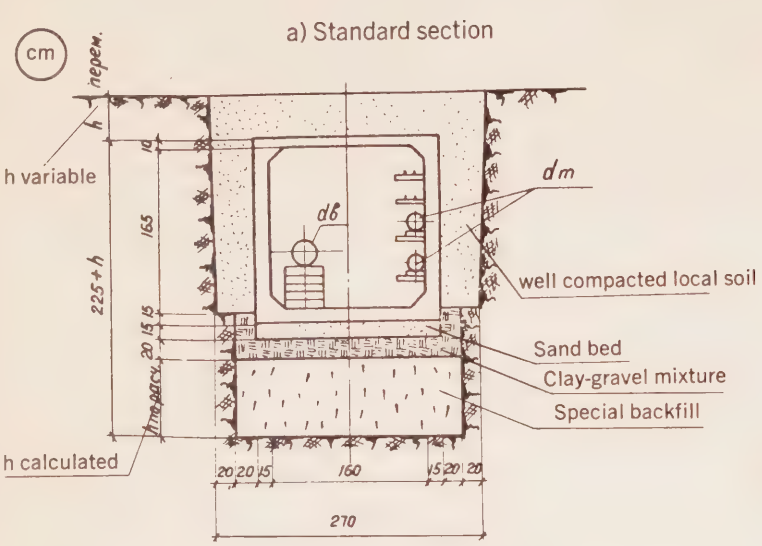
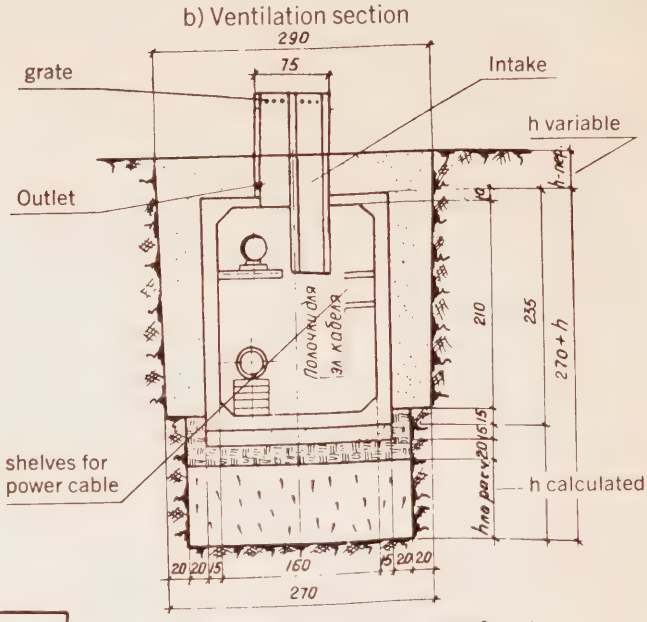
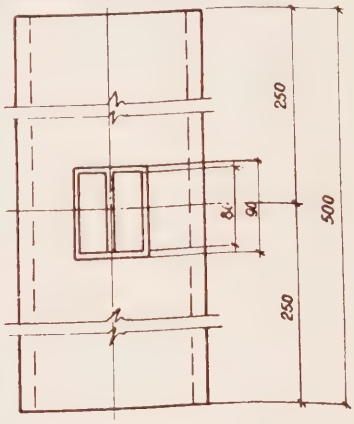


Figure 7
One-level, reinforced concrete, accessible conduit (Norilsk)







Volume of work per linear m of conduit (in cu. m)

No.	Item	Volume
1	Excavation	10,2
2	Monolithic reinforced concrete, M – 300 Mrz – 200	1.27
3	Sand bed	0,24
4	Clay-gravel mixture below the conduit	0,64
5	Special backfill	1,84
6	Backfill	2,75
7	Clay-gravel pads for foundation sills installed every 50 m along the route of the conduit.	0,30

Figure 8
Prefabricated reinforced concrete conduits
(Mirny)

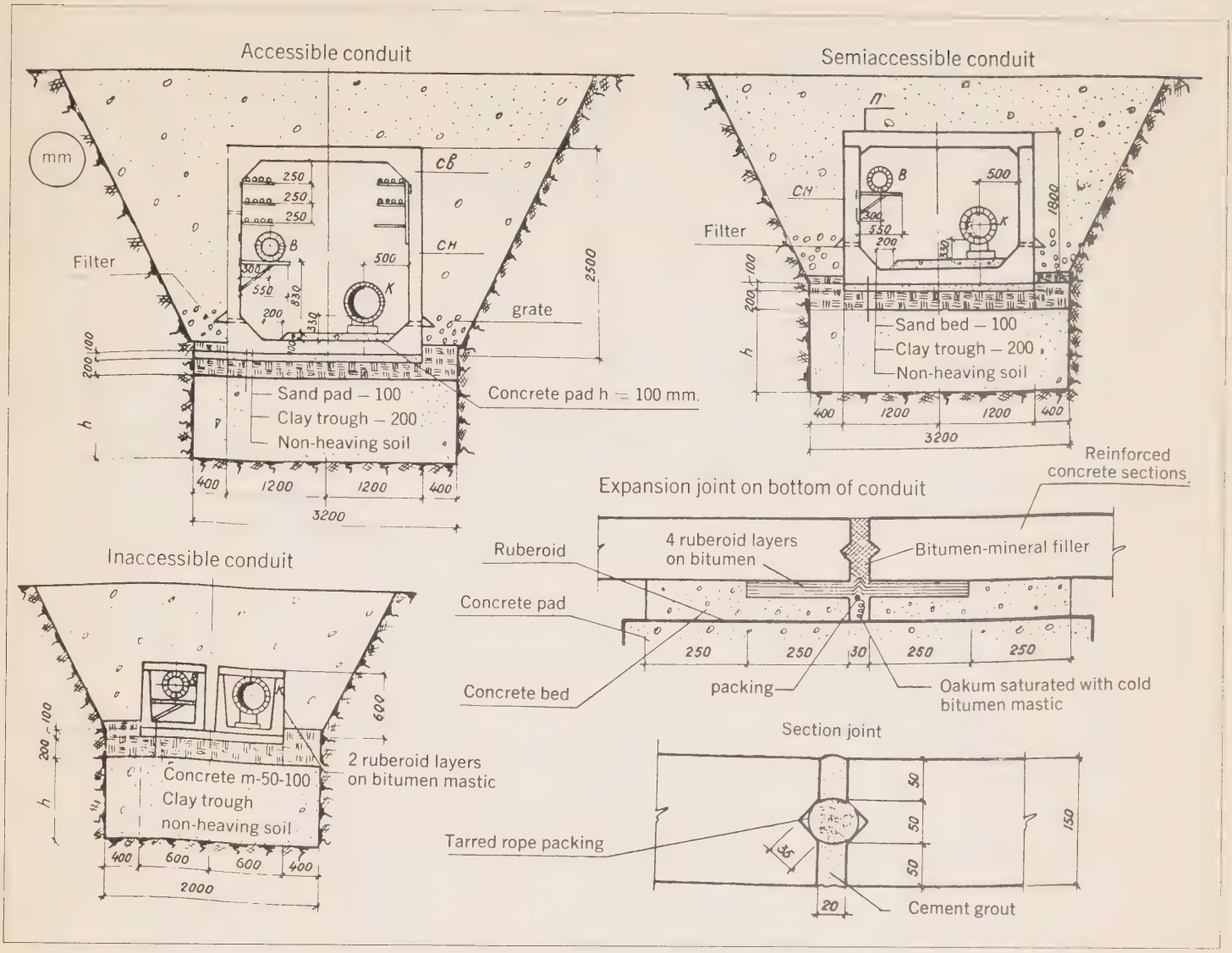
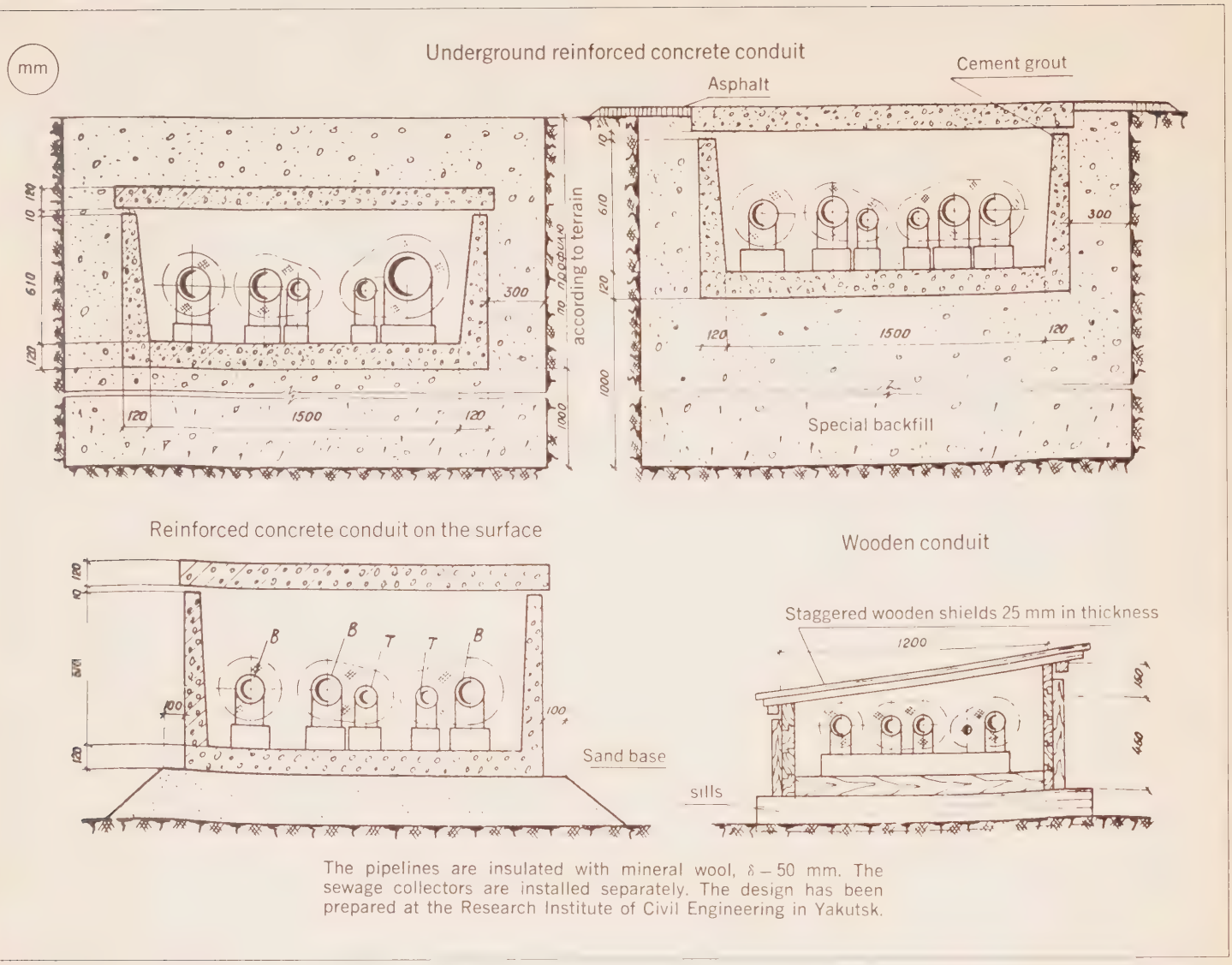


Figure 9
Examples of pipeline installations in Yakutsk



The pipelines are insulated with mineral wool, $\delta - 50$ mm. The sewage collectors are installed separately. The design has been prepared at the Research Institute of Civil Engineering in Yakutsk.

Figure 10
Pipelines in ventilated crawl spaces and on the first floor (Norilsk)

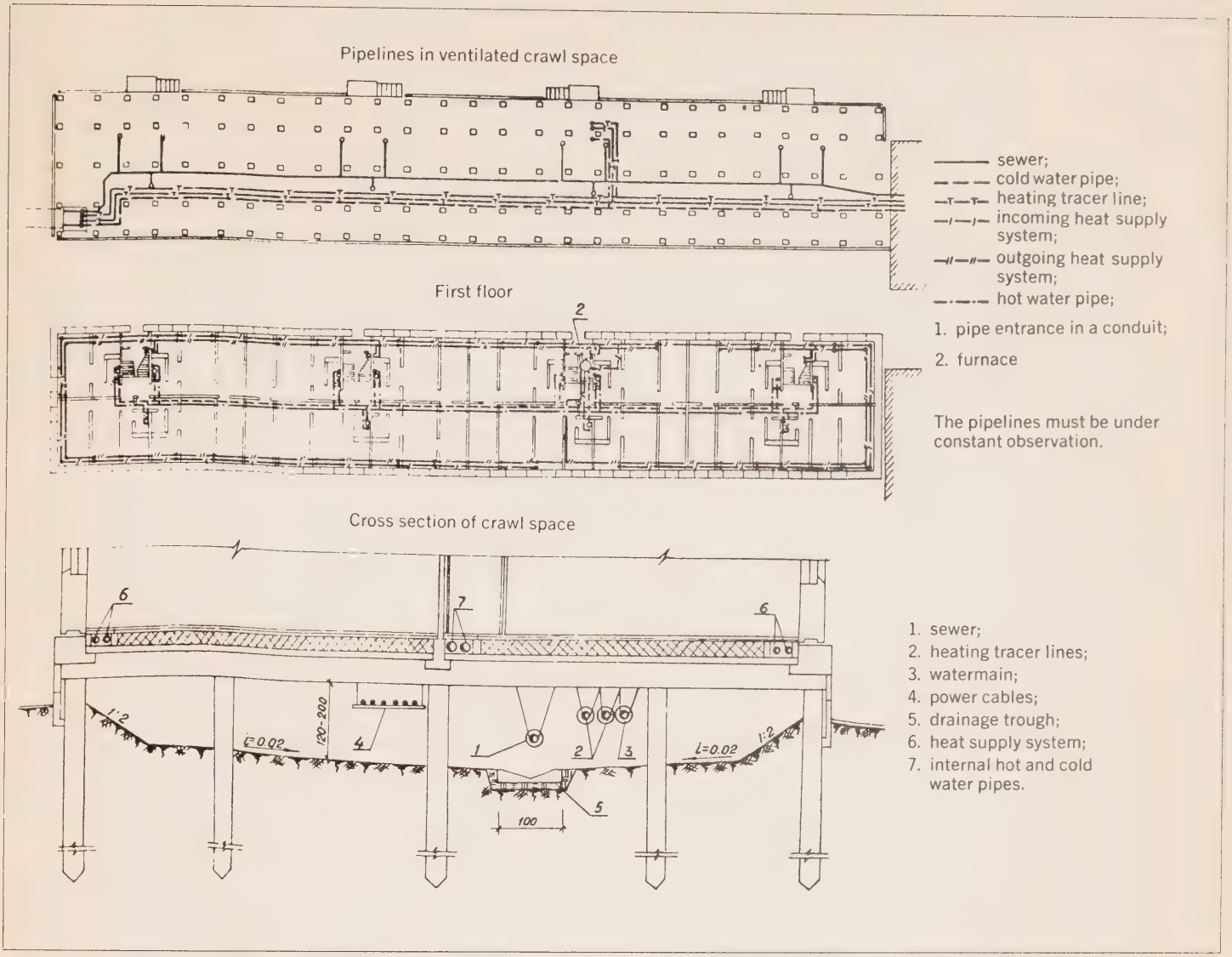


Figure 11
Building connections (Norilsk)

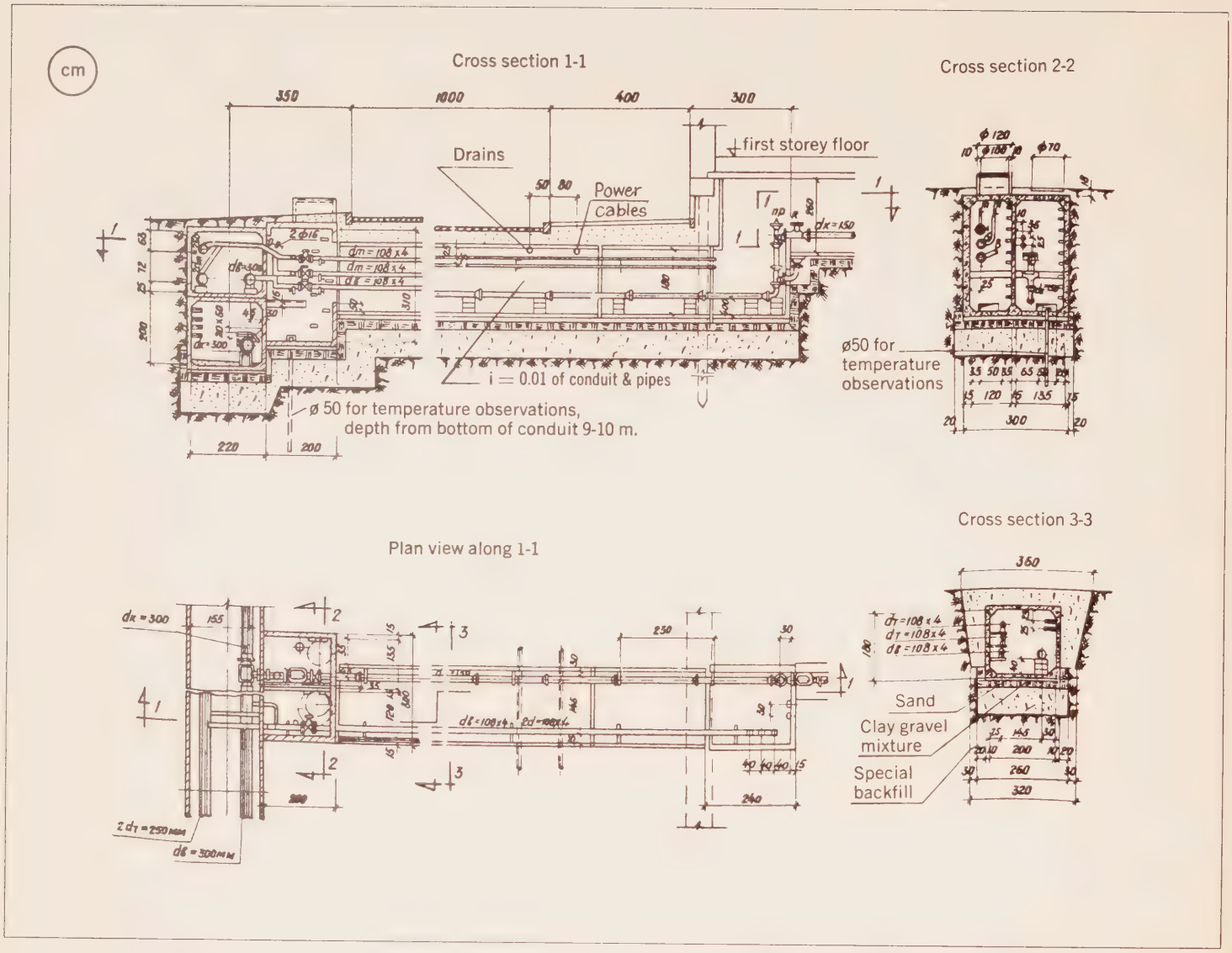
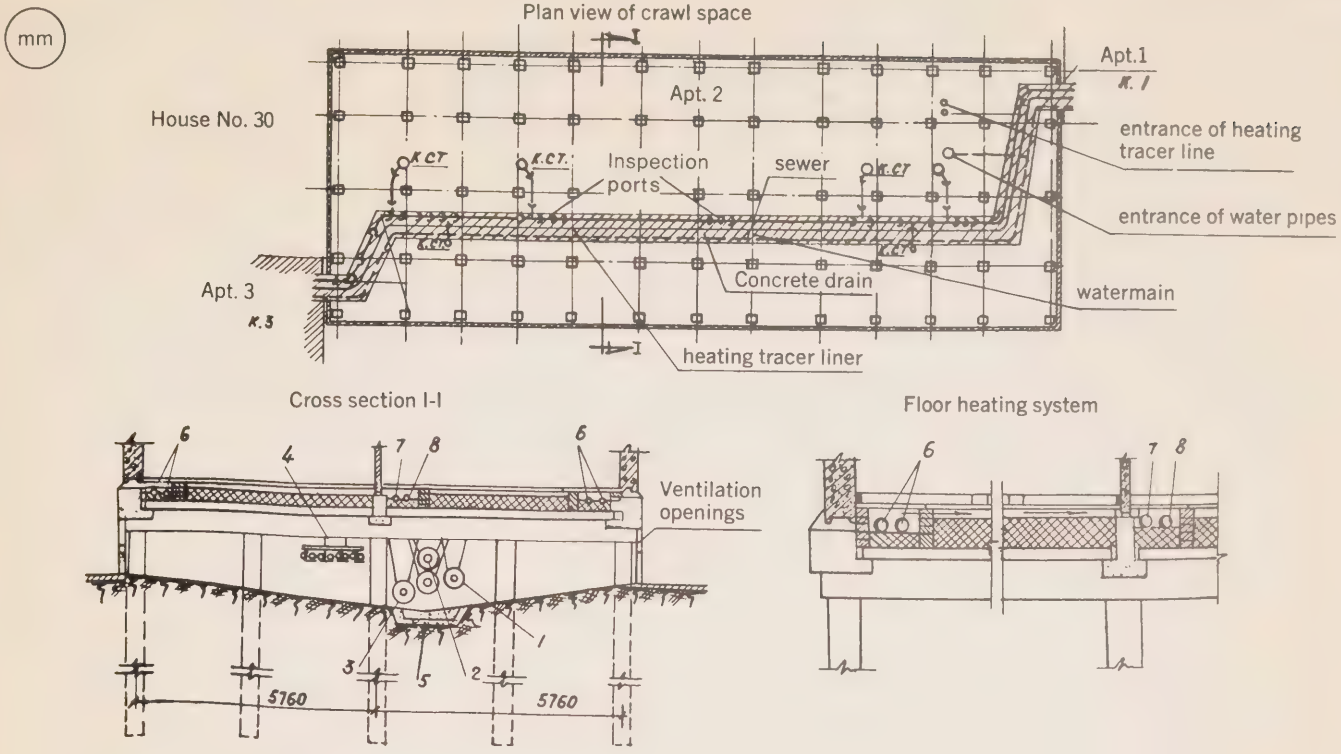
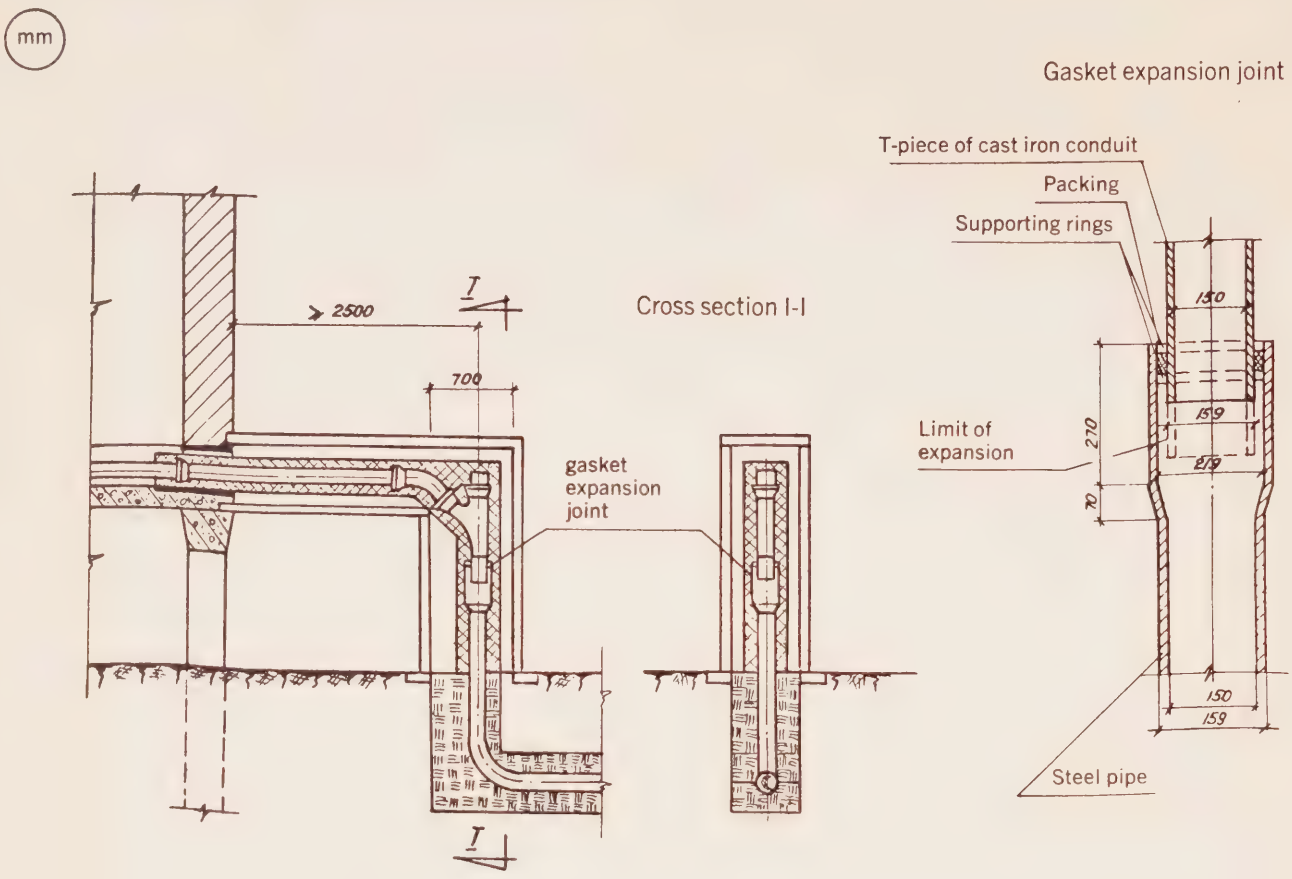


Figure 12
Location of pipelines in a crawl space
(Norilsk)



1. water main;
2. heating tracer lines;
3. sewer pipes;
4. power cables;
5. drain;
6. incoming and outgoing heat supply lines;
7. internal water supply;
8. internal hot water supply.

Figure 13
Sewer Outlet (Yakutsk)



The outlet is insulated with mineral wool ($\delta = 50$ mm), two layers of sackcloth and two coats of hot bitumen (as suggested by the Research Institute of Civil Engineering in Yakutsk).

Figure 14
Road Crossing (Norilsk)

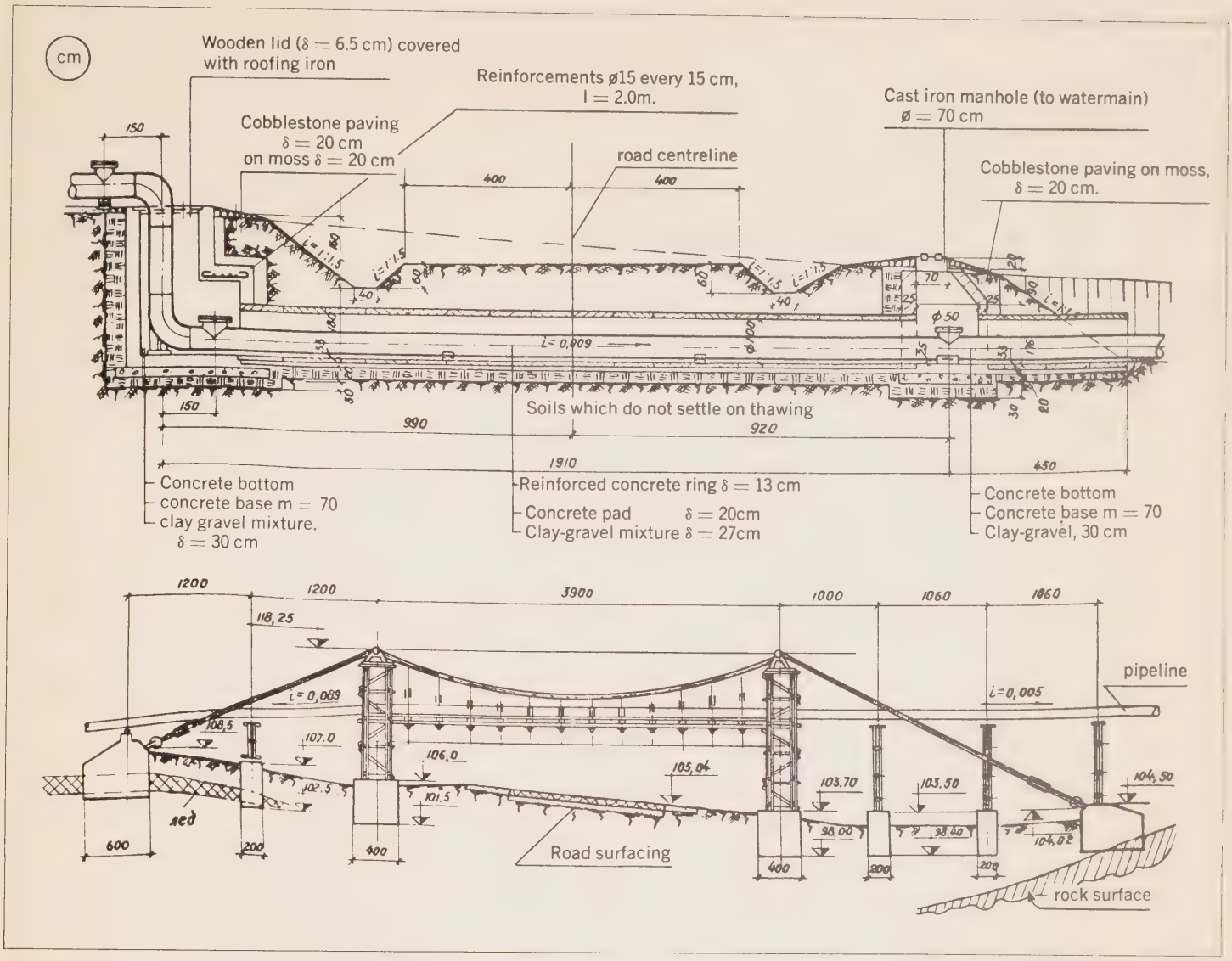
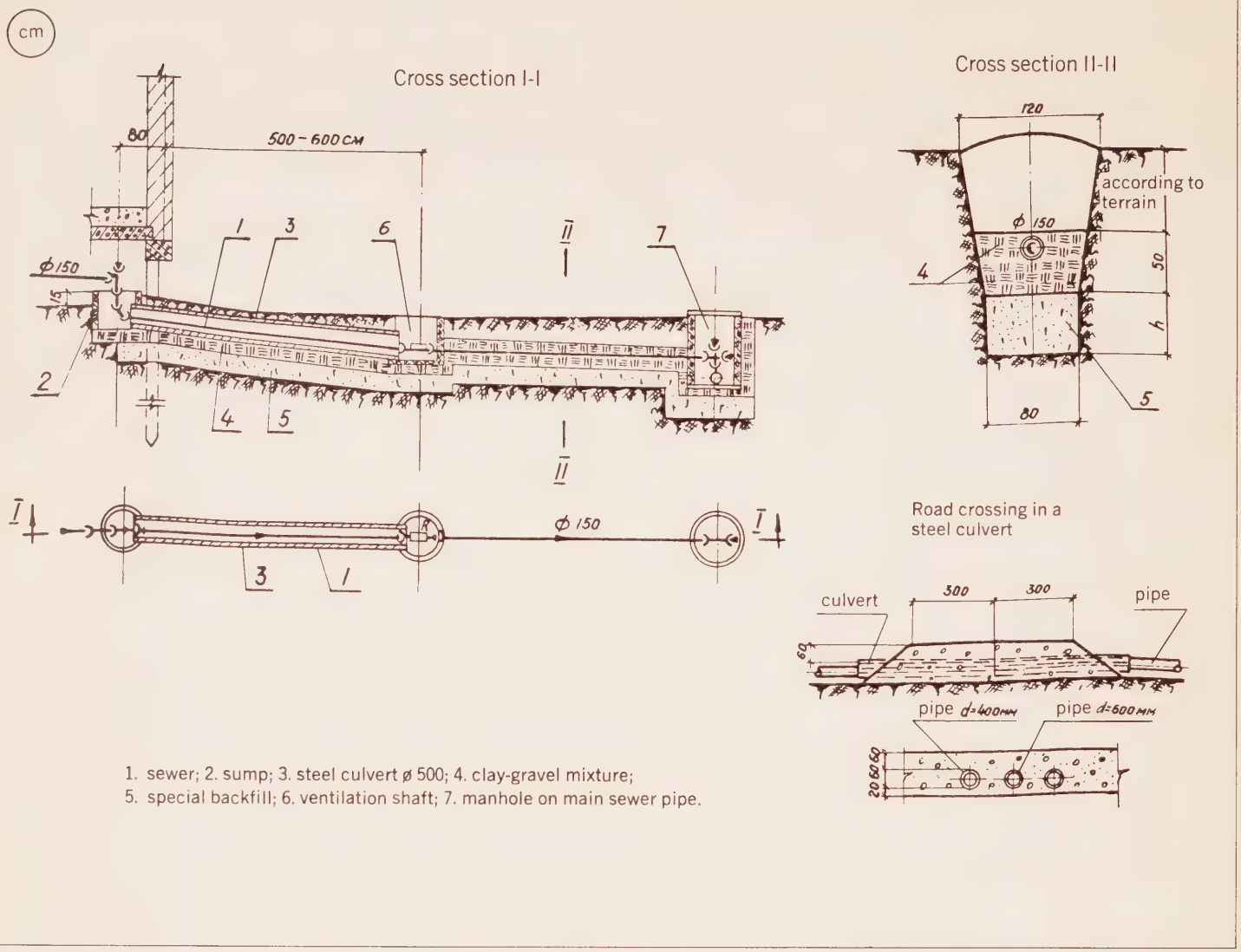


Figure 15
House connection and road crossing
(Norilsk, Dudinka)



1. sewer; 2. sump; 3. steel culvert ø 500; 4. clay-gravel mixture;
5. special backfill; 6. ventilation shaft; 7. manhole on main sewer pipe.

Figure 1
General plan

Appendix 9

Vilyui Hydro-electric Power Station*

The Vilyui generating station was built under severe climatic conditions in a region of continuous permafrost and at a considerable distance from transportation routes. The access roads had to be built in the course of construction.

The Vilyui is in the Eastern-Siberia climatic region, which is distinguished by very cold winters with little precipitation and short summers. Winter lasts for seven months (October—April). The mean annual temperature is —8.2°C and on the coldest days the temperature may drop as low as —63°C.

The hydro-geological regime of the Vilyui River is characterized by a very irregular flow rate: 82 per cent runs off during spring floods, 16 per cent in the summer and fall, and only two per cent in winter. In the course of construction the maximum recorded flow rate in the spring reached 12,700 m^3/sec, while the minimum winter flow rate came to 2.5 m^3/sec. In dry years the river freezes almost to the bottom if the winter is severe.

The river valley cuts through solid dolerite on the construction site and there are numerous rapids. Flat wide stretches of the strand may be seen on both sides of the river between the valley slopes. The deposits on the river bed and the strand consist principally of blocks and boulders embedded in sandy loam or a mixture of sand and pebbles.

The thickness of these deposits ranges from zero to three and sometimes five metres. The geology of contacts between the deposits and the river is more complex due to the presence of both dolerites and accommodating rocks of sedimentary origin (xenoliths) cut through by a thick dolerite intrusion.

The composition of xenoliths is not uniform and these rocks are regarded as being semi-consolidated and not water resistant. The surface of the dolerite mass is strongly fractured.

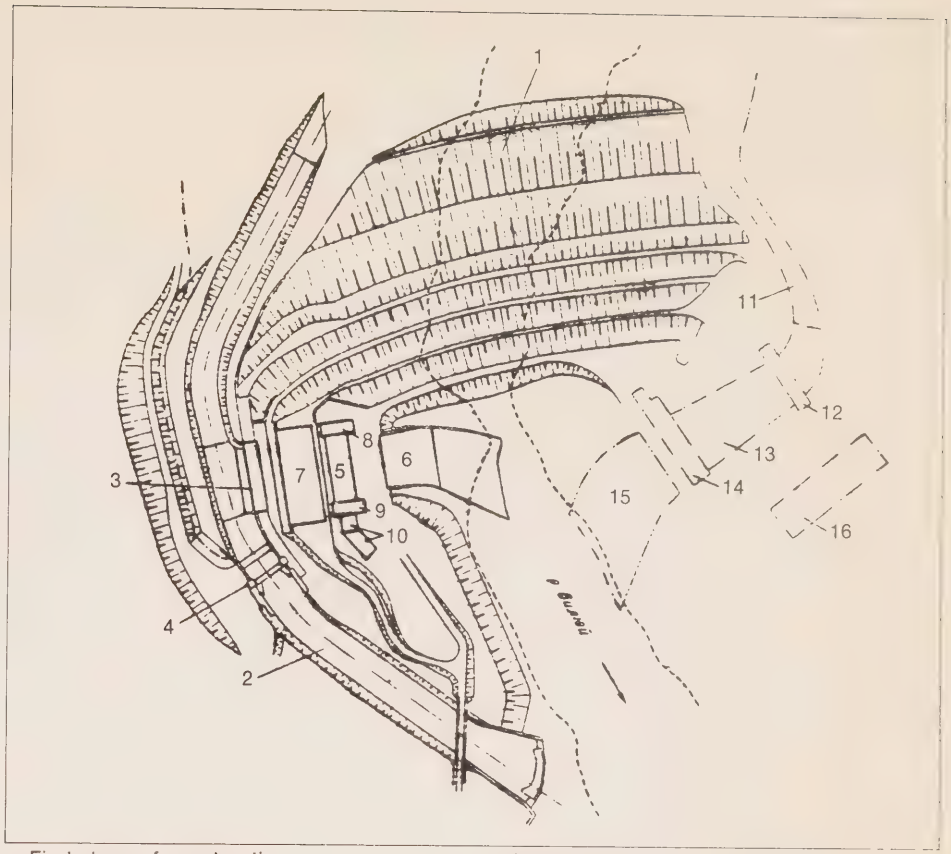
Local construction materials, i.e., rock for the body of the dam, sand for concrete, and cohesive soils for the waterproofing of the dam, were available in sufficient quantities. The effective thickness of cohesive soils (products of dolerite weathering) is not considerable and does not exceed 0.6—1.5 metres.

Construction was carried out far from railroads and waterways and a year-round highway was completed only in 1966. Construction under such adverse conditions was difficult for both builders and designers.

The output parameters of the station were based on the prospective growth of power loads with allowances for electric heating, heat supply and total electrification of the region. The design was prepared at Gidroproekt Institute. The design of the dam, the methods of construction and the work program were modified in the course of construction.

*Translated from Russian by V. P. Poppe, National Research Council.

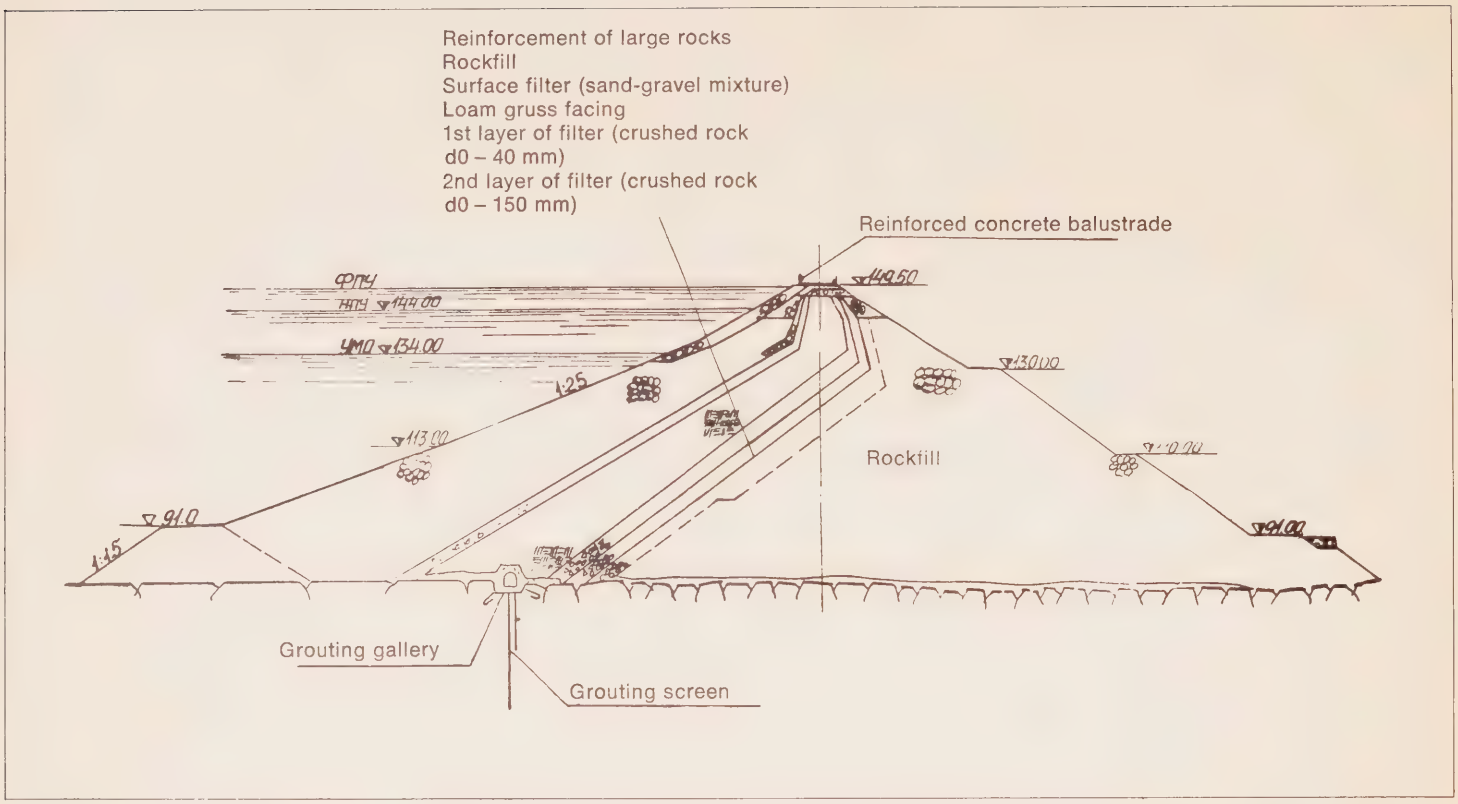
Paper presented to delegates at Chernyshevski.



First stage of construction
1 Dam
2 Spillway channel
3 Intake
4 Spillway
5 Powerhouse
6 Tailrace canal
7 220 kv closed switch room
8 Control building
9 Reloading station
10 Auxiliary and administration buildings

Second stage of construction
11 Headrace canal
12 Intake
13 Penstocks
14 Powerhouse
15 Tailrace canal
16 220 kv switch room

Figure 2
Cross-section of the dam



Main structures of the dam

The general layout of the Vilyui power station is shown in Figure 1.

Tree clearing is to be carried out only in the vicinity of the power complex and the structures are protected from floating logs and peat islands by traps and boat patrols.

The temporary construction base and the settlement of Chernyshevski accommodating construction workers and operational personnel are located on the right bank of the river.

The rockfill dam is 75 metres high. The dam is slightly curved in plan view. The transition zone below the facing is designed in the form of two filtering layers. The first sub-facing layer consists of crushed rock of grain size 0—40 mm, the grain size in the second layer ranges from 0 to 150 mm.

The facing consists of a mixture of clay loam and rock waste which are the products of frost weathering of dolerite. These soils are found in the quarries resting on bedrock in 0.6—1.5 m-thick layers below a 0.3 m-thick top soil and vegetation layer. The grain size of the soil within the development layer is not uniform. Smaller fractions are found on the surface: the content of coarse-grained soils increases with depth. The specific characteristic of this soil is a very high coefficient of heterogeneity: D_{60}: D_{10} = 800—1000. There has been no previous use of such soils in dam construction. The suitability of this soil for the dam facing was determined in extensive laboratory and field tests, carried out from 1959 to 1963 by the department of underground structures and foundations at the M. I. Kalinin Polytechnical Institute in Leningrad. The tests revealed that the placement of alternating thawed and frozen layers in the facing is possible, providing the soils were sufficiently compact before freezing.

Discharge during construction

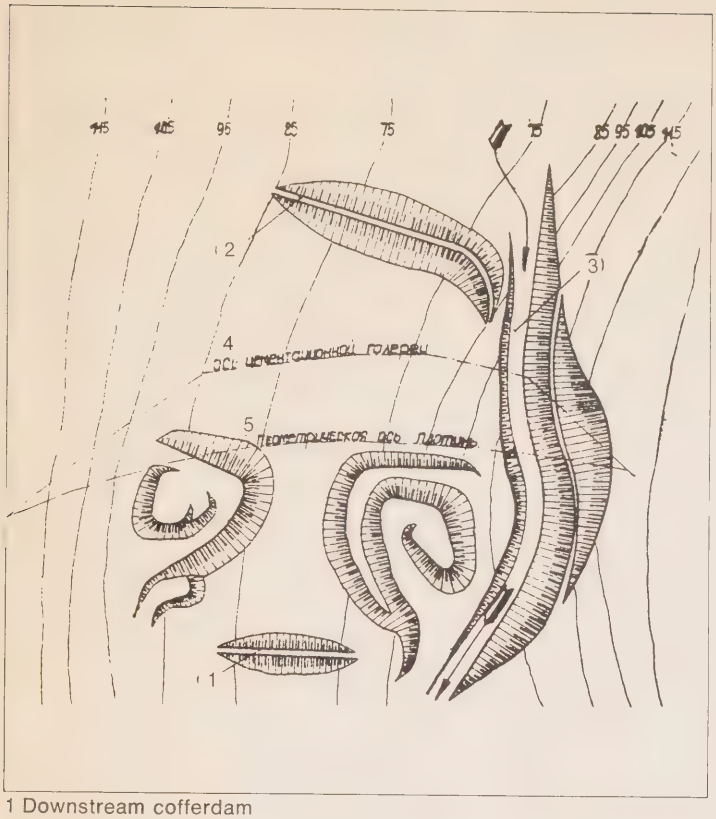
Having investigated various possibilities, the final plans called for discharge through the construction trench on the left bank of the river. The design of the entrance to the trench ensured that throughout the entire range of discharge there would be backwater and the rate of flow would not cause erosion. To reduce the volume of excavation a temporary slope of the rockfill was used at the right wall of the entrance to the trench. Below the entrance the rate of flow in the trench increases.

Before completion of the construction trench the rockfill was placed near the banks only. The river channel was narrowed down in this way to an opening 75 m wide, which was sufficient to discharge the spring flood without causing erosion. It was planned to block the opening completely in the fall if construction of the trench would be completed by the following spring.

In one winter season it was necessary to block the 75 m opening in the river channel with rockfill to a height of 40 m and place the facing to a height of 20 m (which meant filling with about 150,000 m^3 of clay loam) so that the remaining part of the facing could be placed in the summer. Provision was made for seepage through the rockfill above the unfinished facing and the rockfill was covered with one layer of filter of coarse rock fragments. The lower part of the rockfill slope was made less steep and strengthened with rocks of non-standard size. The filtration stability of this type of rockfill had been confirmed experimentally.

The plan was to block the construction trench in the fall after the discharge of summer and autumn floods and prior to the start of the spring flood. The dam had to be raised therefore to a height of 50 m in one winter season. The volume of facing within the construction trench came to about 12,000 m^3 and had to be placed at temperatures below zero (March - April). Hence about 50 per cent of the clay loam facing had to be placed in winter.

Figure 3
Discharge prior to spring flood of 1964

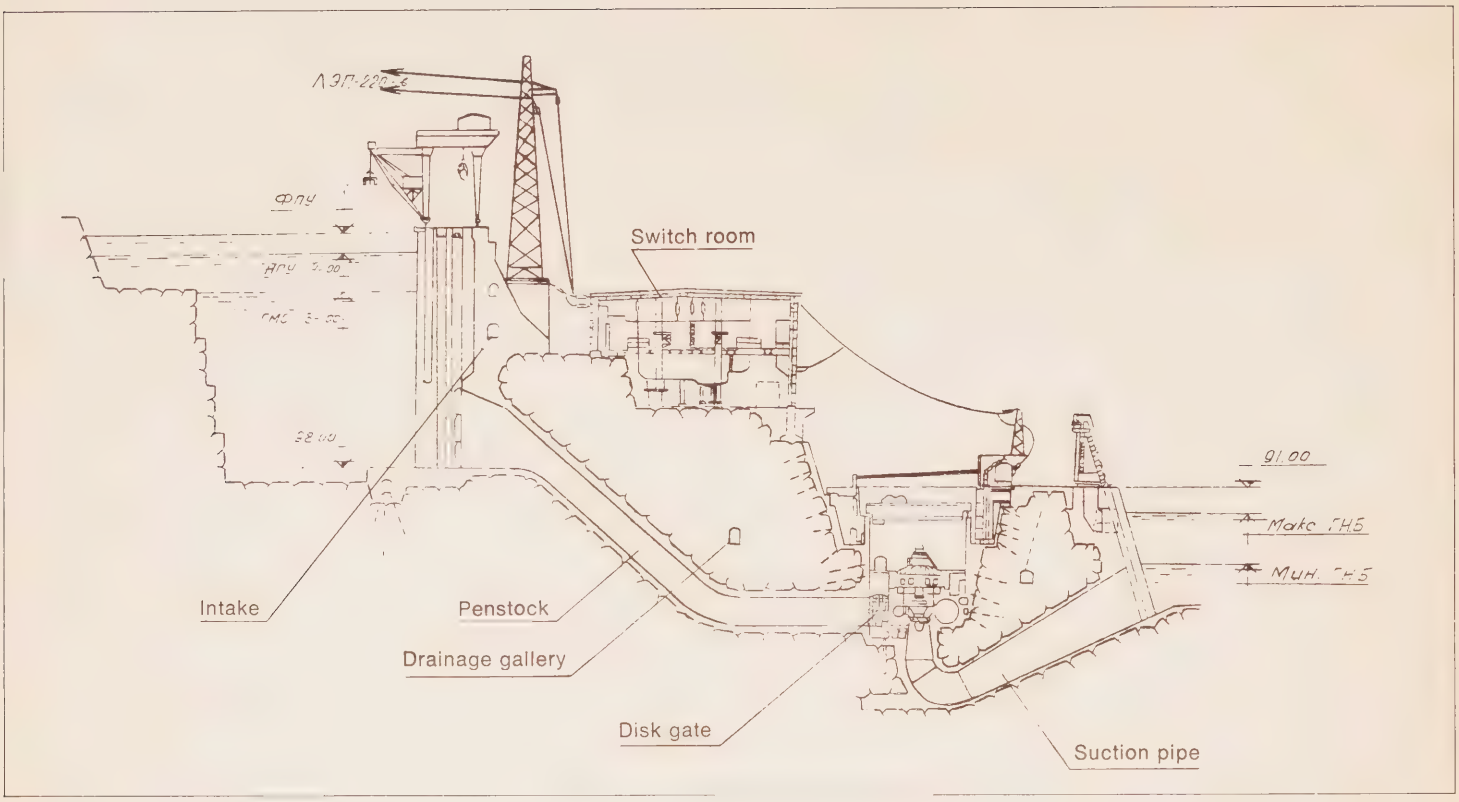


1 Downstream cofferdam
2 Upstream cofferdam
3 Construction trench
4 Axis of grouting gallery
5 Geometric axis of dam

Figure 4
Discharge during spring flood of 1965

1 Rockfill
2 Clay loam facing
3 Upstream cofferdam
4 Reinforced concrete plates on the slopes
5 Construction trench

Figure 5
Cross-section along the axis of the powerhouse



The spillway channel passes mainly through the dolerite. In places the excavation exposed low-strength sedimentary rocks (the xenoliths). The channel was excavated to a depth of 55 m, the grade of slopes ranged from 1:1 to 5:1 and 10:1. An embankment was constructed in the curved section of the channel beyond the spillway. A series of steps were made in order to create satisfactory hydraulic conditions at the entrance to the tailrace.

The spillway has one opening provided with a segmental 14 meter-high gate. The discharging capacity of the spillway is about 5,000 m^3/sec. The decision to shut the spillway with a single gate without intermediate buttresses was dictated by fear of blockage with floating logs. Provision of a single gate will ensure a trouble-free passage of logs into the tailrace. The maintenance gate in front of the segmental gate consists of single bracing trusses installed by means of a cable crane. The deep-water-type intake is on the left bank of the spillway canal above the spillway. The entrance openings of the intake are connected to the penstocks. The openings contain recesses for the installation of gratings and a maintenance gate. The intake is served by a crane with a mobile jib, and a cleaning device. The power house is of semi-underground type and is situated in a deep trench cut in rock. Excessive fracturing of dolerite made it necessary to reduce the steepness of the banks of the trench and to reinforce them by means of a concrete facing and anchoring.

The rock around the machine room is drained by means of boreholes and tunnels from which water is removed into the drainage well by gravity flow. The machine room is served by one bridge crane with a lifting capacity of 350/75/10 metric tons and a span of 21 m. The crane rails and the roof trusses in the machine room are supported by reinforced concrete walls joined to the concrete facing on the sides of the trench. A reloading station with a bridge crane having a lifting capacity of 50/10 metric tons and a span of 13 m is provided for the transfer of goods from the yard to the assembly site.

The power station has rotary-blade turbines, some of the most powerful of their type in the world. Because of the semi-underground location of the station, the installation of the rotor below the level of the tailrace was achieved practically without any increase in the volume of construction. The use of rotary-blade turbines resulted in a significant reduction in the diameter of the rotor and an increase in the number of rotations of the unit. This in turn greatly reduced the weight of the unit and the size of the machine room, as compared with installations incorporating radial-axial turbines.

The operational experience gained over a period of more than three years shows that the Khar'kov Turbo-generator plant, the manufacturer of the Vilyui turbines, produced a workable and original design of turbine.

The suction pipes are installed in tunnels. To retain rock pillows between the tunnels, the horizontal cross-sections of the suction pipes are constant and at the joints there is an increase in vertical cross-sections only. The exits of suction pipes are covered by flat, sliding maintenance gates suspended from a movable mechanism with a lifting capacity of 60 metric tons. The water from the suction pipe is discharged into a sump shaft.

The control building, the reloading station and the auxiliary building consist of metal frames, prefabricated reinforced concrete roofs, and walls made of lightweight aggregate concrete blocks. The administration building has a similar design, except that there is no metal frame in the bearing walls.

The 220 kV switch room is of a closed type to ensure a trouble-free performance of electrical equipment at temperatures as low as −65°C. The building has a metal frame, a prefabricated reinforced concrete roof and walls made of aluminum panels with a synthetic foam filler.

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